MACHINERY

JULY 26, 1961

ONE SHILLING & THREEPENCE

ASQUITH

The PORTABLE UNIVERSAL RADIAL of modern design

The machine illustrated is a 5' 0" radius Portable Universal Radial.

UP-TO-DATE FEATURES

Shaft drive from Motor (no belts)

Ball bearing rolls to "in" and "out" traverse of arm

Wide range of feeds and speeds

Quick return after tapping

Power and hand elevating and lowering to arm

Exceptional ease of control

A robust machine of up-to-date design which ensures trouble free operation. It incorporates a large number of ball journal bearings; special attention has been paid to efficient clamping of the swivelling parts and shaft drive from the motor is a noteworthy modern feature. The arm can be elevated in a dead vertical position to facilitate tool changing, etc. Write today and ask for full details of the Asquith Portable Radial.

Built in 4 sizes with radius 4 ft., 5 ft., 6 ft. or 7 ft.

WILLIAM ASQUITH LTD.
HALIFAX · ENGLAND
Member of the Asquith Machine Tool Corporation

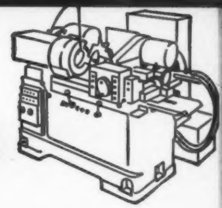
Sales and Service for the British Isles

DRUMMOND - ASQUITH LIMITED

Member of the Asquith Machine Tool Corporation

KING EDWARD HOUSE, NEW ST., BIRMINGHAM *Phone: Midland 3431.* Also at LONDON *Phone: Trafalgar 7224* & GLASGOW *Phone: Central 0922*

HERE'S HOW HEALD INTERNAL GRINDERS



provide FLEXIBILITY

● through the electro-hydraulic Universal Feed Mechanism which gives easy set-up by a simple dialling system for

● Wheel Retraction ● Start of Coarse and Fine Feeds ● Coarse and Fine Feed Rates ● Wheel Dressing Point ● Wheel Wear Compensation

Additionally, table traverse rates for dress, rough and finish grind are infinitely variable. ALL settings can be locked in position to ensure constant production.

GAGE-MATIC AND SIZE-MATIC, PLAIN AND TOOLROOM MODELS

BELT DRIVEN WHEELHEAD UP TO 100,000 R.P.M.

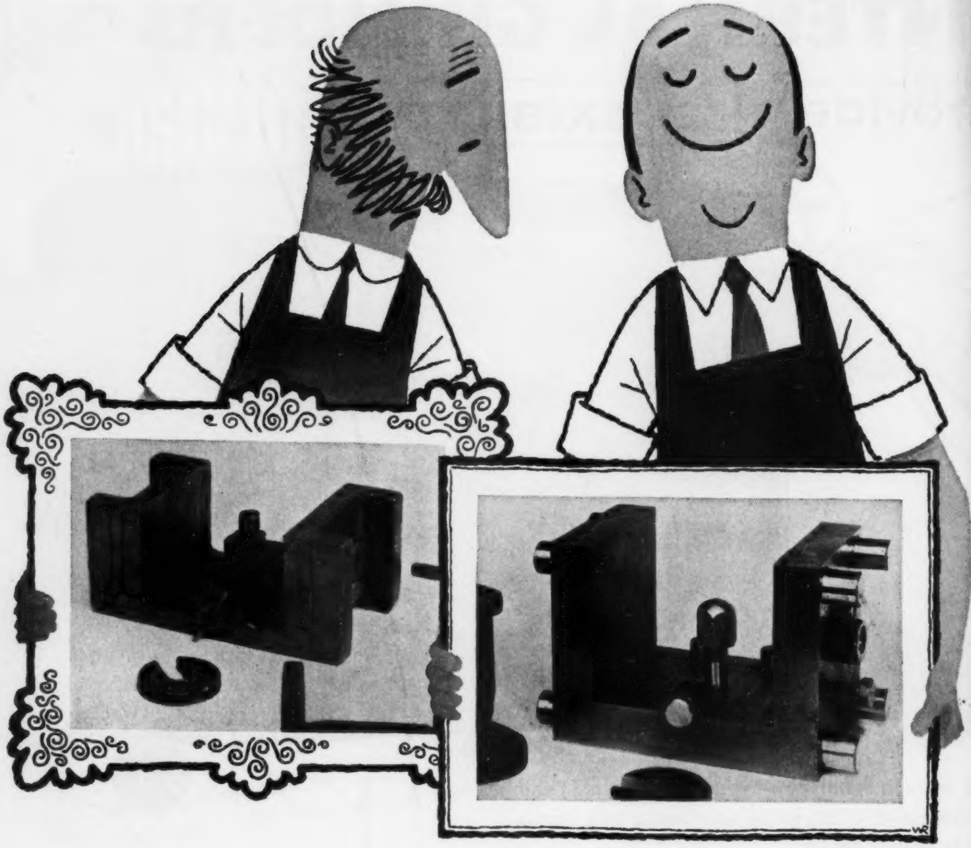
ATTACHMENTS FOR FACE GRINDING, COMBINATION BORE AND FACE GRINDING, FORM GRINDING ETC.

You'll find IT PAYS to come to—

HEALD

HEALD MACHINES LIMITED • BIRMINGHAM 24 • ENGLAND

Sales Representatives • **ALFRED HERBERT LIMITED • COVENTRY**



Old fashioned methods of building jigs and fixtures can waste valuable time and money. By using Purefoy Standard Parts, however, you will save money in both Drawing Office and Tool Room and be ready for production more quickly and cheaply than ever before. The jig on the right above is a typical example. Made almost entirely from Purefoy Standard Parts, it was less than two-thirds the cost of the welded jig and the saving in time was even greater. There are several hundred items in our range and we hold large stocks of them ready for immediate delivery.

PURFOY STANDARD PARTS

Further information, reference lists, etc., free on request to

PUREFOY UNIT TOOLING LTD., Upper Tilt Works, Cobham, Surrey.

Telephone : Cobham, Surrey 3013.

When answering advertisements kindly mention MACHINERY.

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When answering advertisements kindly mention MACHINERY.

RIGI

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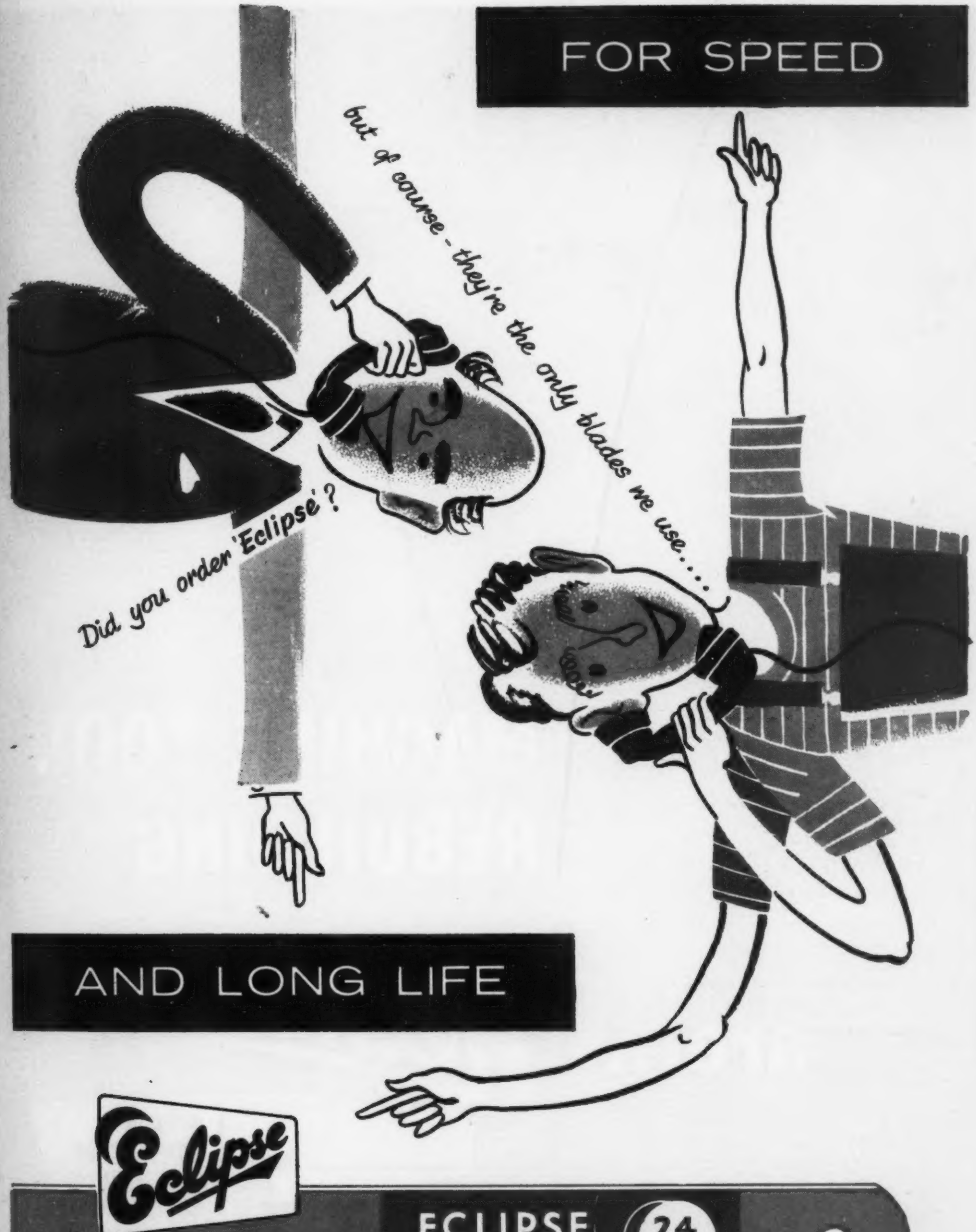
FOR SPEED
but of course - they're the only blades we use.....
Did you order 'Eclipse'?
AND LONG LIFE
Eclipse
ECLIPSE
24 TEETH
HIGH SPEED STEEL
USE AN ECLIPSE FRAME

1961

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Churchill

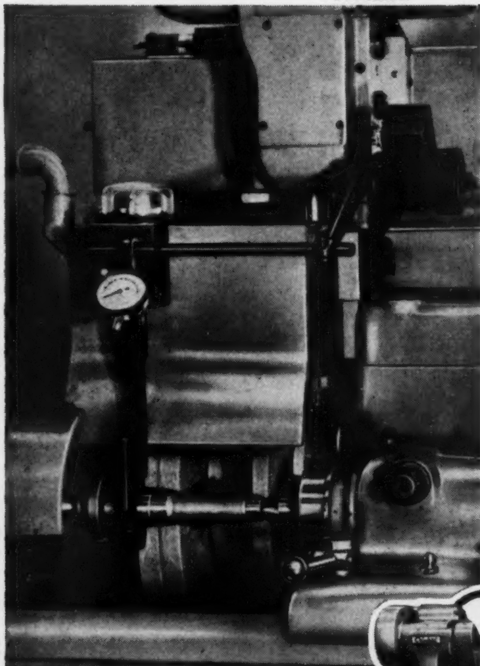
AUTOMATIC

SIZING OF WORKPIECE

TRUING OF GRINDING WHEEL

COMPENSATION FOR WHEEL TRUING

CYCLE CONTROL FOR NUMBER OF WORKPIECES

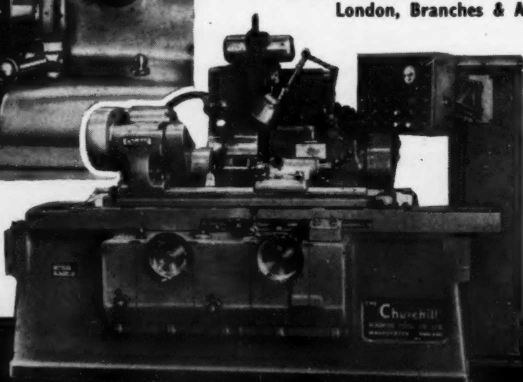


on

Model 'BW'
Plain
Grinding Machine

THE CHURCHILL MACHINE TOOL Co Ltd
Broadheath, nr. Manchester.
Altrincham 3262

Export Sales Organisation
ASSOCIATED BRITISH MACHINE TOOL MAKERS LTD
London, Branches & Agents



Home Selling Agents
CHARLES CHURCHILL & CO. LTD
Birmingham & Branches

BRUSSELS EXHIBITION—Churchill 'BW' Plain and 'HBM' Internal Fully Automatic Grinding Machines will be shown on Stand 2007 at the 7th European Machine Tool Exhibition, September 3rd–12th, 1961.

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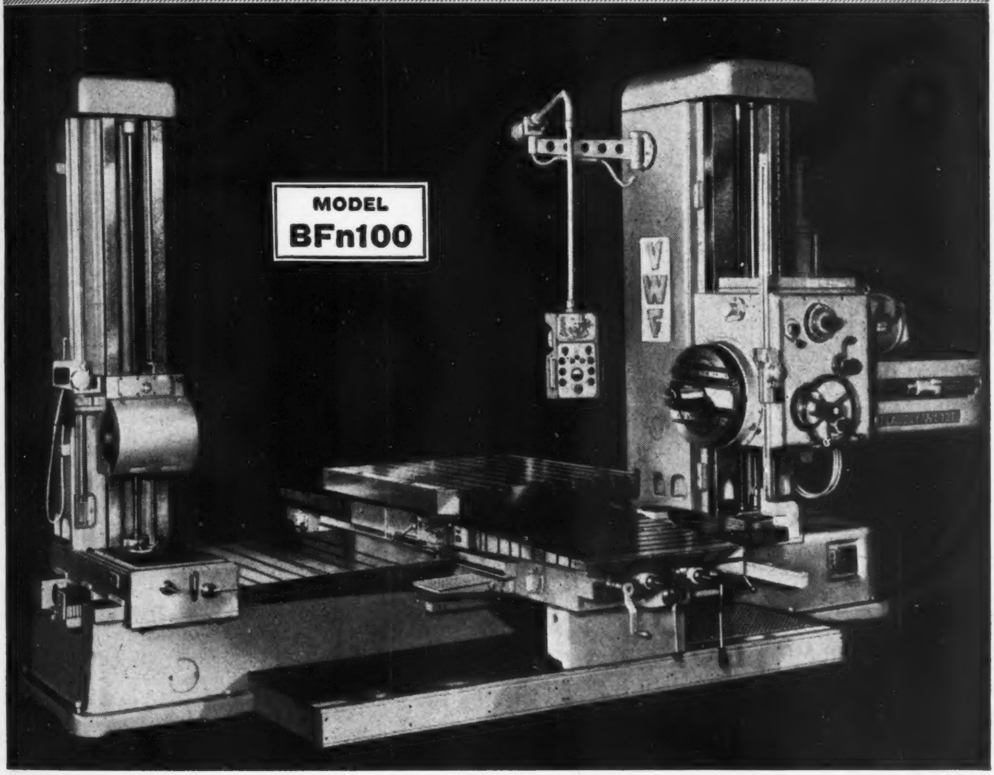
VWF PLAUERT-WETZEL

Horizontal Boring and Milling Machine



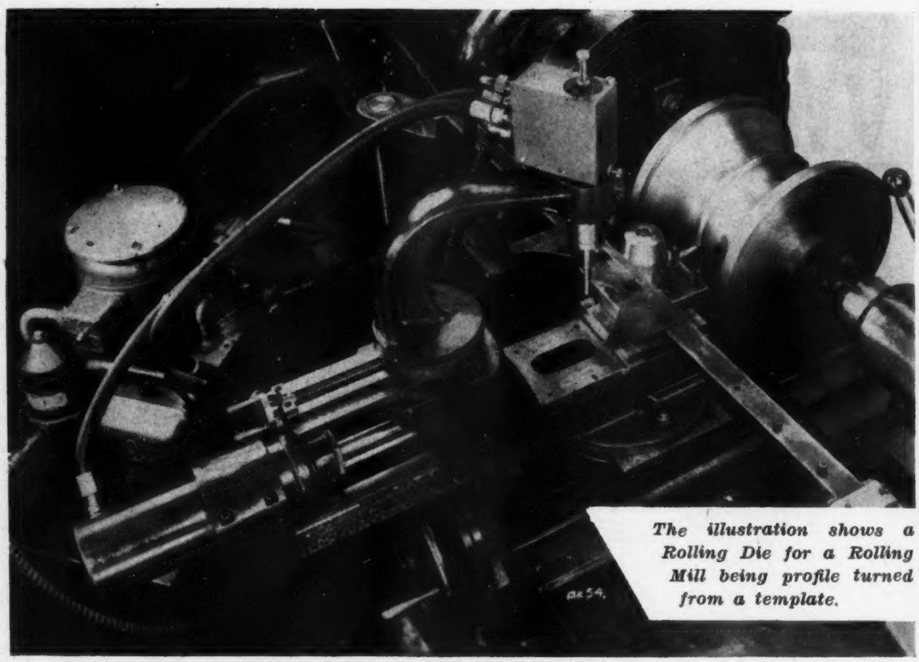
- Boring and milling spindles can be engaged individually or together, at identical or different speeds.
- Pre-selection of a wide range of spindle speeds and feeds, controlled from pendant station.
- Precision scales for co-ordinate settings, Optical fine setting equipment available as an extra.
- Rapid tool clamping in boring spindle by steep angle taper and quick-acting locknut.
- Adjustable, hardened outboard supports for the table slide; included as standard equipment.
- Fully automatic, timed lubrication of slideways, feed mechanism and spindles.

Brief description Model BFn 100

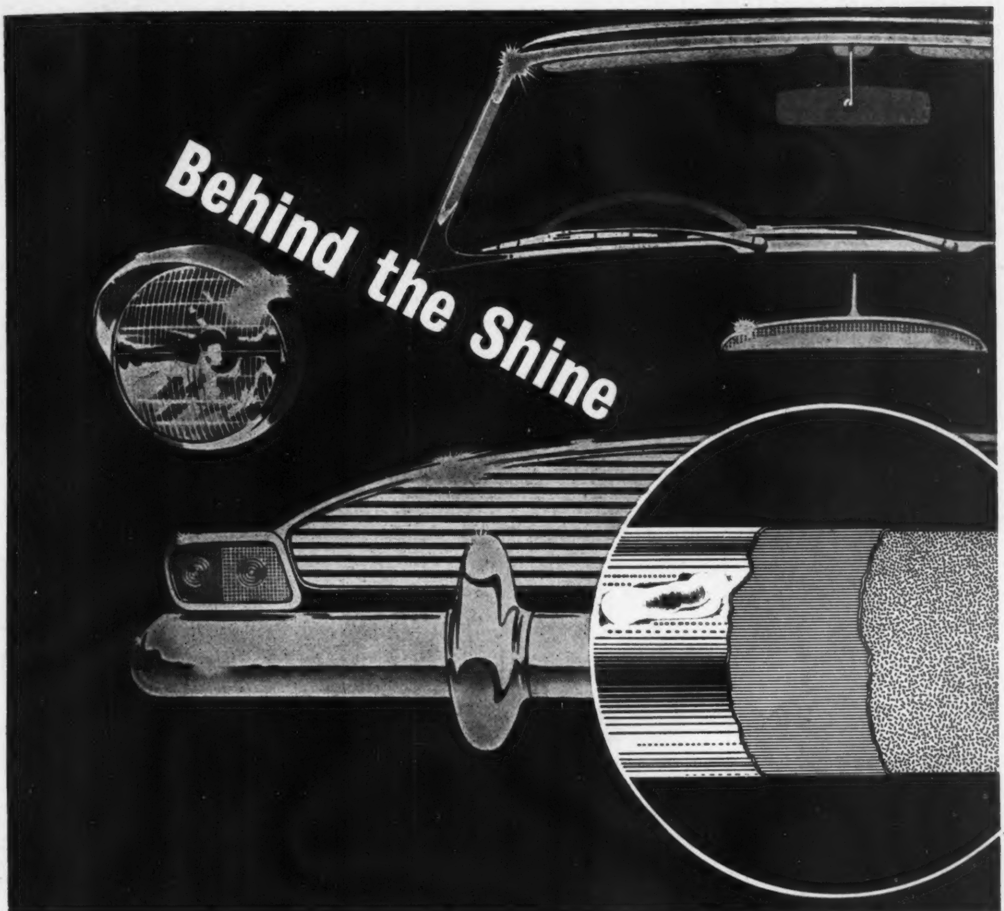
Table dimensions	50 in. x 55 in.
Table load, max.	8 tons
Distance between faceplate and steady	124 in.
Height of work spindle above table	0-55 in.
Cross and longitudinal traverse of table	69 in.
Boring spindle diameter	3.94 in.
Milling spindle diameter	7.09 in.
Boring depth in one traverse/with resetting	35/49 in.
Maximum diameter bored	35 in.
Facing diameter, max.	44 in.
Spindle speeds	9-1400 r.p.m.
Rapid traverse (all directions)	138 in./min,
Main motor	20 HP.
Weight (net, with steady)	17 tons

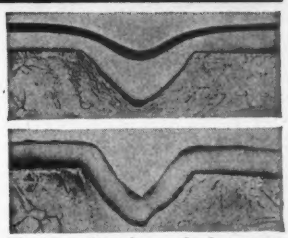
other models are available

Sole British Agents
SYKES
Machine Tool Co. Ltd
Hythe Works, The Hythe
Staines, Middlesex
Telephone
Staines 55474 (5 lines)
Telegrams Sytool Staines



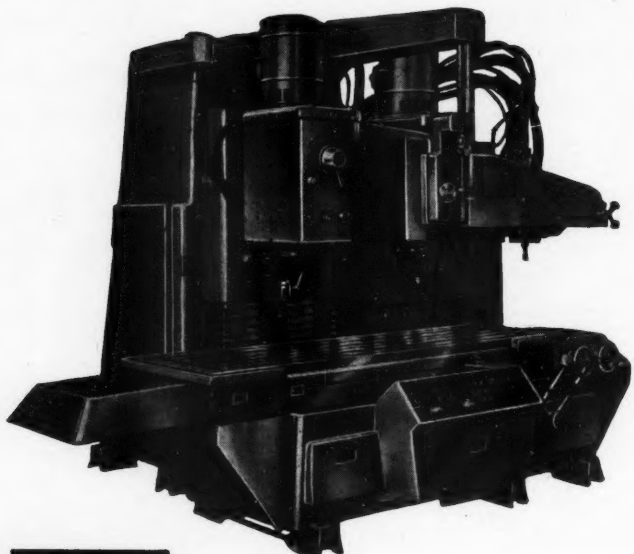
The illustration shows a Rolling Die for a Rolling Mill being profile turned from a template.





The above photomicrographs demonstrate the levelling effect of Harshaw Duplex Nickel as compared to that of conventional grey nickel.
Top: *Perflow-Perglow Duplex Nickel-depth of scratch 2.7 mils*
Bottom: *Grey Nickel-depth of scratch 2.7 mils*

Copies Left- and Right-hand die halves simultaneously



SWISS **RIGID**

AUTOMATIC HYDROCOPYING DIE SINKER MODEL KAB 250

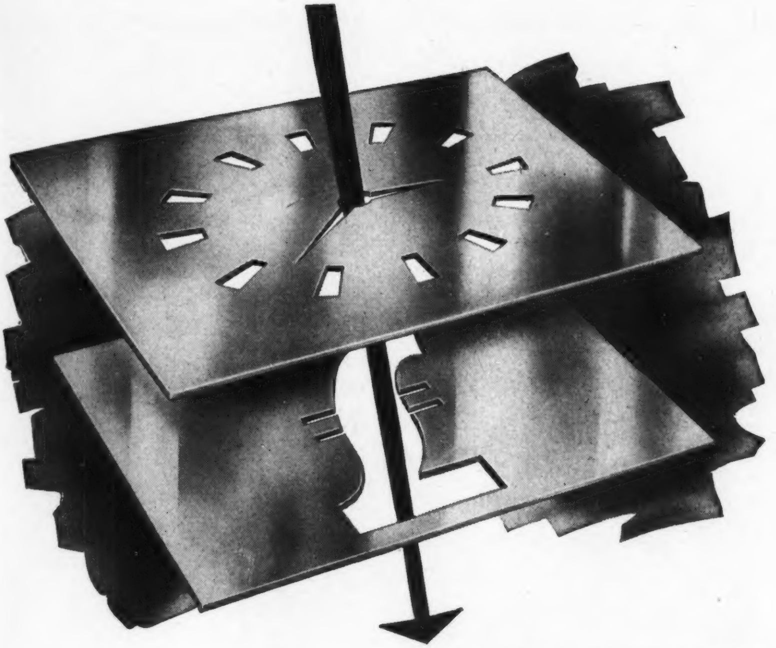
Fully automatic — roughing and finishing — this exceedingly robust bed-type machine copies 3-dimensional dies, without supervision, from wooden or plaster models. Both left- and right-hand halves of the die can be copied at the same time from the same master. 360° profiling can be performed at constant feed, without rotating circular tables, *and* on vertical contours. Servo hand control permits speedy roughing. The machine has two spindles; single- and 4-spindle machines are available also.

Table size 130" × 25⅝". Spindle speeds (18) 42 to 2000 r.p.m.
Copying feeds, steplessly variable ·4" to 15·75". Pick feeds ·006" to ·2".

Send for fully illustrated brochure M/188.

SOLE U.K. DISTRIBUTORS:

DOWDING & DOLL LTD
346 KENSINGTON HIGH STREET, LONDON, W.14
Tel: WESTERN 8077 (8 lines) Telex: 23182 Grams. ACCURATOOL LONDON TELEX



WIEDEMANN

pierces the Time and Cost Barrier ....

Wiedemann cuts the cost of short and medium run piercing by as much as 85% and does the job much better and much faster. No more marking out—No more setting up, drilling, fly-cutting, chiselling out or finishing to size and *no more costly tooling*. Modifications or complete changes of layout made quickly, easily, cheaply.

Write for Wiedemann Brochure No. M/176 and study the 'hole' time and cost question — and send sketches of some of your jobs and ask for time studies.

BRITISH WIEDEMANN TURRET PUNCH PRESSES

RA. 41P with pantograph table and stylus for rapid hole location. Throat depth 28" with 16, 18 or 20 turret stations. 30,000 lbs. capacity. Other models—hand and power operated—15,000 to 160,000 lbs. punching pressure.

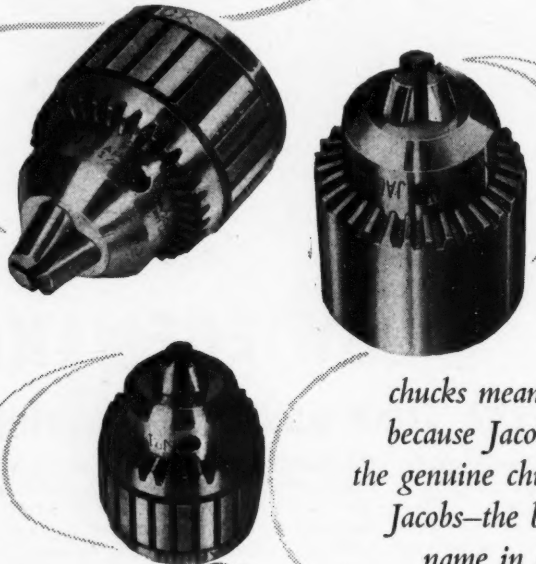
DOWDING & DOLL LTD

346 KENSINGTON HIGH STREET, LONDON, W.14

Tel: WESTERN 8077 (8 lines) Telex: 23182 Grams: ACCURATOOL LONDON TELEX

176

"What I really mean to say is . . ."



"You mean chucks mean Jacobs chucks because Jacobs chucks are the genuine chucks made by Jacobs—the best known name in chucks"

"Your dealer can supply genuine Jacobs chucks in all sizes for light, medium or heavy duty"

INSIST ON GENUINE

Jacobs

CHUCKS

THE JACOBS MANUFACTURING CO. LTD., ARCHER ROAD, SHEFFIELD, 8

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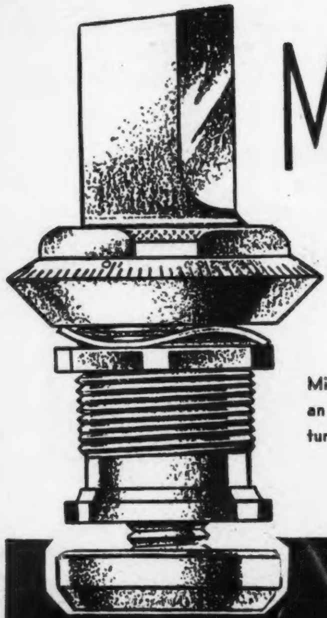
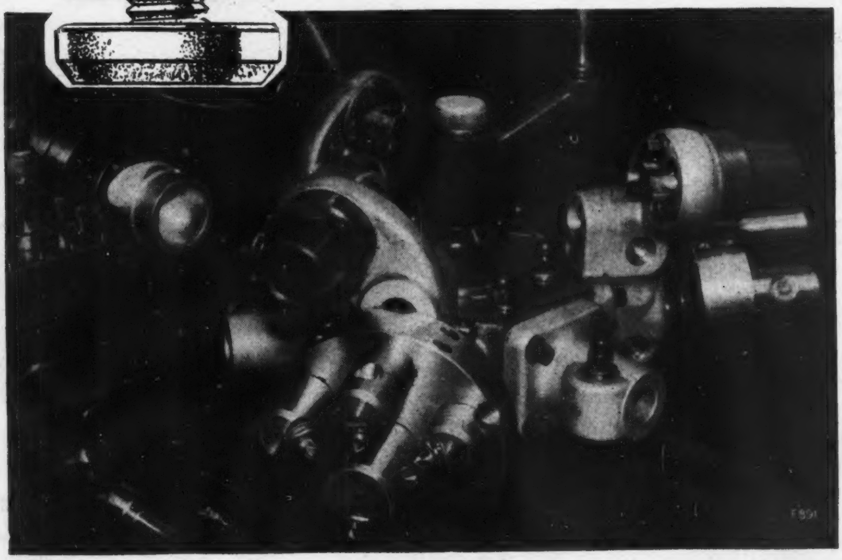


MICROBORE

precision tooling

Microbore tooling set-up on a Herbert No. 2D capstan lathe for machining an aluminium alloy component in a total time of 60 seconds. Five diameters turned, faced and bored simultaneously using cluster tooling.



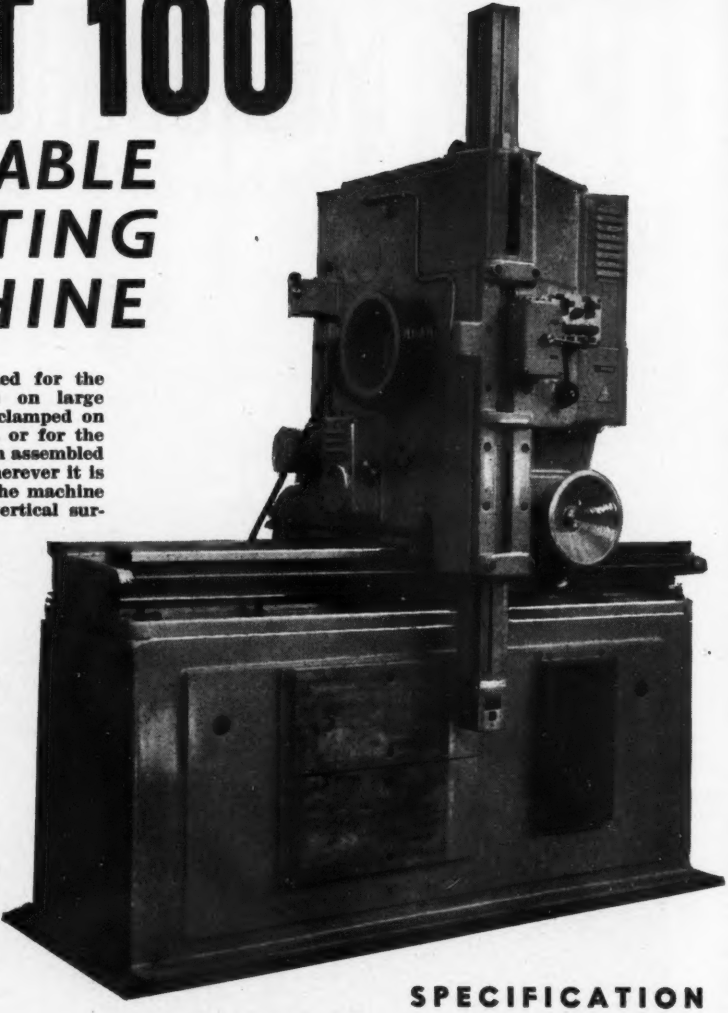
The Microbore eliminates trial-and-error methods of setting a single-point cutting tool for precision machining on lathes and boring, drilling and milling machines. Grouping these units, as illustrated, provides all the advantages of a specially-designed multi-tooling set-up but is inexpensive and is extremely flexible. Each cutting edge can be independently adjusted to micrometer precision, is easily replaceable and can be independently ground. Microbore Units or complete bars for specific set-up supplied. Six types and fifty sizes of Units available.

ALFRED HERBERT LTD., COVENTRY *Factored Division, Red Lane Works.*

AD483

HOT 100

PORTABLE SLOTTING MACHINE



The machine is designed for the machining of surfaces on large parts which cannot be clamped on standard machine tools, or for the machining of surfaces on assembled machines. It is used wherever it is advantageous to move the machine to the workpiece and vertical surfaces are machined below the level of the machine. The HOT 100 portable slotting machine is especially well-suited in heavy engineering works where it is easier to take the machine to the job than the job to the machine. It is transported by means of a crane.

Immediate Delivery from our Leeds Showroom (Subject to Prior Sale)

SPECIFICATION

Slotting height: maximum	39¼in.
Slotting height: minimum	11¾in.
Movement of housing on bed	59in.
Transverse movement of housing	9 13/16in.
Number of ram speeds	3
Cutting speeds of ram per minute	18ft.-26ft.-36ft.
Return speed of ram per minute	52ft.
Maximum force at all speeds	1,760lbs.
Longitudinal and cross feed per one stroke of ram	0.008in.-0.04in.
Rapid movements of housing per minute	33ft.
Main drive motor: output	3.7kW
Main drive motor: speed	940 r.p.m.

SOLE AGENTS

Selson MACHINE TOOLS

The Selson Machine Tool Co. Ltd

SUNBEAM ROAD, LONDON, N.W.10. Telephone Elgar 4000

STANNINGLEY, Near LEEDS Telephone Pudsey 2241

And at Kingsbury (Nr. Tamworth), Manchester, Glasgow, Swansea, Newcastle-on-Tyne, Sheffield, Southampton, Belfast, Bath

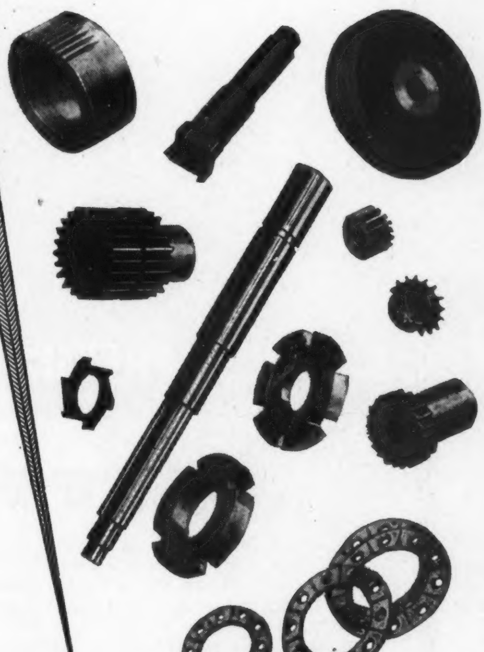
600 GROUP

. . . for cutting spur gears and splines in shafts and slots down to ·014" wide, in trick cylinders the . . .

EDGWICK

GEAR & SPLINE CUTTING MACHINE

- ★ **POWERFUL DRIVE**
- ★ **EXTREMELY RIGID AND DURABLE**
- ★ **ACCURATE INDEXING MECHANISM**

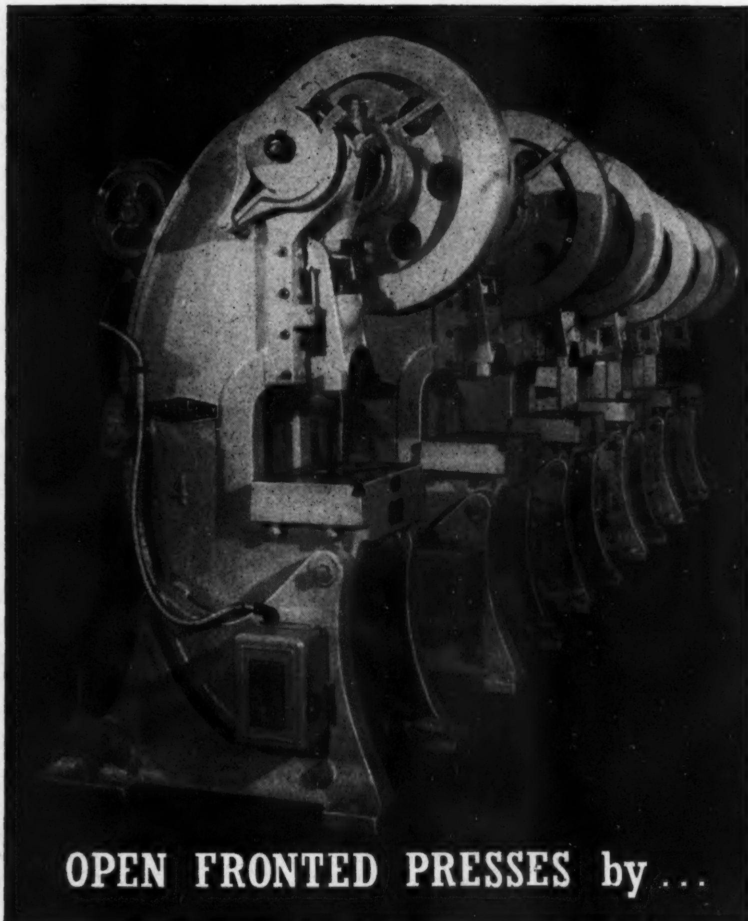


Available in both Plain and Universal form, the latter having a swivelling cutter slide enabling spur or bevel gears to be cut and other angular work index milled.

Capacities	*Plain*	*Universal*
Max. diameter	*36"*	*24"*
Max. stroke of cutter slide	*8"*	*4½"*
Max. pitch, Cast Iron	*5 D.P.*	*5 D.P.*
" " Steel	*6 D.P.*	*6 D.P.*

ALFRED **HERBERT** LTD., COVENTRY *Factored Division, Red Lane Works.*

AD 549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MEDDINGS INCA

Hydraulic Multi-spindle drilling machines

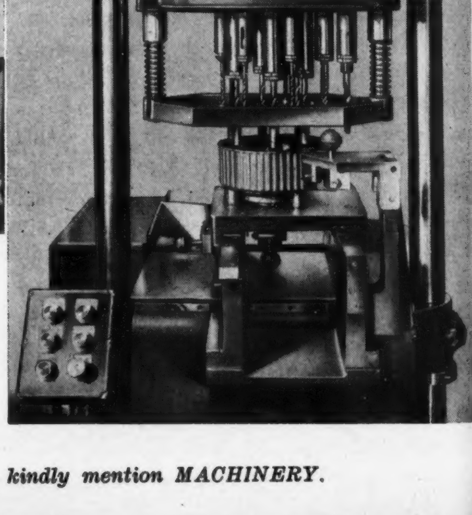
Visit us on Stand
6103, HALL 6
7th European Machine Tool Exhibition, Brussels, September 3—12

These hydraulic up-stroking multi-spindle drilling machines provide fast approach, accurately controlled drilling feed and fast return of the worktable after completion of drilling. They are extremely flexible in use and can be fitted with driving motors of up to 15 h.p. — the thrust available from standard machines can be varied up to 8,000 lbs.

The machine illustrated is one of two recently supplied to a customer for the quantity production of Brake components. Provision is made for fast changeover of multi-spindle Heads and tooling, and the machines were supplied complete with all necessary jigs and fixtures built to customer's requirements.

'Patterning' of multi-spindles enables one machine to cater for a number of different parts—Heads with up to 90 spindles are in course of production.

A complete range of fixed centre and adjustable type multi-spindle Heads for attachment to existing machines, together with a comprehensive tooling service are also available.



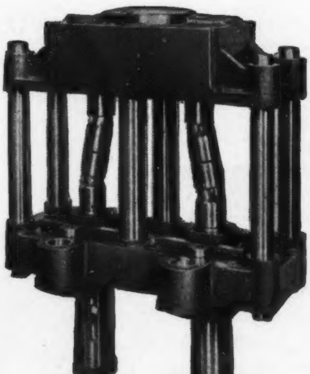
Write for full particulars to:

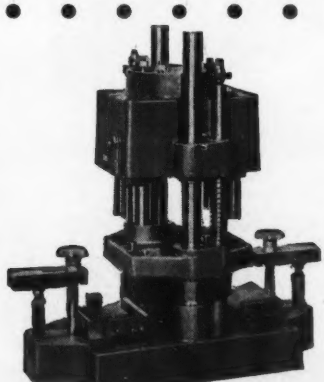
W. J. MEDDINGS LTD
IPSWICH ROAD · TRADING ESTATE · SLOUGH · BUCKS
Telephone: Slough 26761 (5 lines)

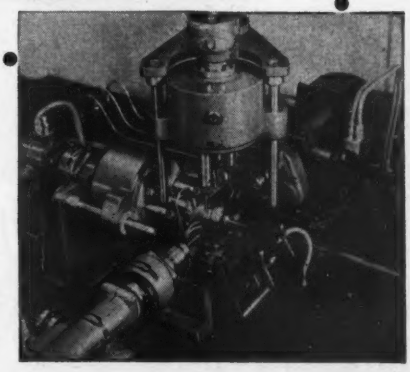
VISIT US ON STAND
6103, HALL 6
7th European Machine Tool Exhibition, Brussels, September 3rd to 12th, 1961

LET'S PUT OUR HEADS TOGETHER ON YOUR DRILLING PROBLEM

We supply precision built multi-spindle drilling and tapping Heads to suit your machine—for light, medium or heavy work and with spindles up to No. 5 M.T. Geared, gearless and adjustable types are available to meet your requirements. Additionally, we can supply complete tooling, fixtures, bushplates etc. for your particular application. We design and build special-purpose machines incorporating multi-spindle Heads to meet your own specific needs.







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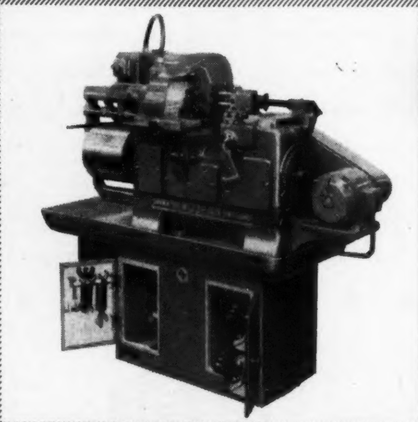
with MODERN automatics



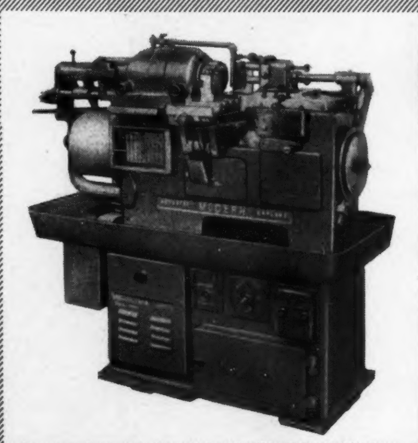
TYPE 904

CAPACITY

Round Bars. Dia.	7/8"
Hexagon Bars. A/F ...	0·71"
Square Bars. A/F	9/16"
Maximum Travel of Tailslide ...	2"
Maximum Travel of cross slide ...	1 7/8"

SPINDLE SPEEDS

Speed Range ...	810-2,500 r.p.m.
No. of Speeds	14



TYPE 907

CAPACITY

Round Bars. Dia.	1 1/4"
Hexagon Bars. A/F	1·01"
Square Bars. A/F	7/8"
Maximum Travel of Tailslide ...	2 1/2"
Maximum Travel of cross slide ...	1 3/8"

SPINDLE SPEEDS

Speed Range ...	280-1,900 r.p.m.
No. of Speeds	12

MODERN

Modern Machine Tools Ltd

P. O. BOX 56 · GOSFORD STREET · COVENTRY

Telephone: Coventry 22132/6 Cables: 'Modern' Coventry

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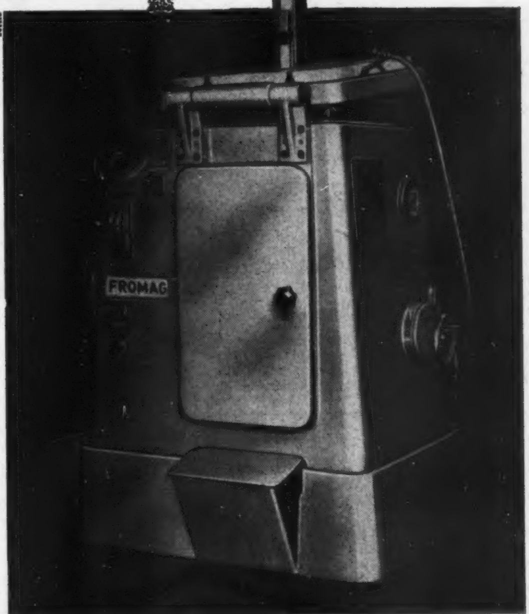
ALL THESE INTERNAL FORMS ARE EASY WITH A ...

FRÖMAG

KEYSEATER



There is a FROMAG Keyseater to suit your requirements whether keyways are from $\frac{1}{8}$" to 10" wide, up to 98" in length, bores from $\frac{1}{2}$" to 59" diameter can be handled.

This range of machines are economic units whether for mass production, small batch quantities or single parts, where high accuracy, efficiency and speed are a necessity. They can handle small pinions with $\frac{1}{2}$" bore to ships' propellers with 5' bores weighing 30 tons.

Model KZ.50 for keyways from $\frac{1}{8}$" to $1\frac{3}{4}$" in width and up to $17\frac{3}{4}$" length.

Even 25% utilisation makes the FROMAG Machines an economic proposition. A combined tilting and floating table can be suppled for cutting keyways in cylindrical bores and for keywaying taper bores. The larger machines can also be used as vertical broaching machines, 6-ton capacity.

MORTIMER

EXCLUSIVE DISTRIBUTORS OF THE FINEST MACHINE TOOLS

NRP 5080A

RTIMER MACHINE TOOL CO. LTD · MORTIMER HOUSE · ACTON LANE · LONDON NW10 · Tel: ELGar 3834-5-6

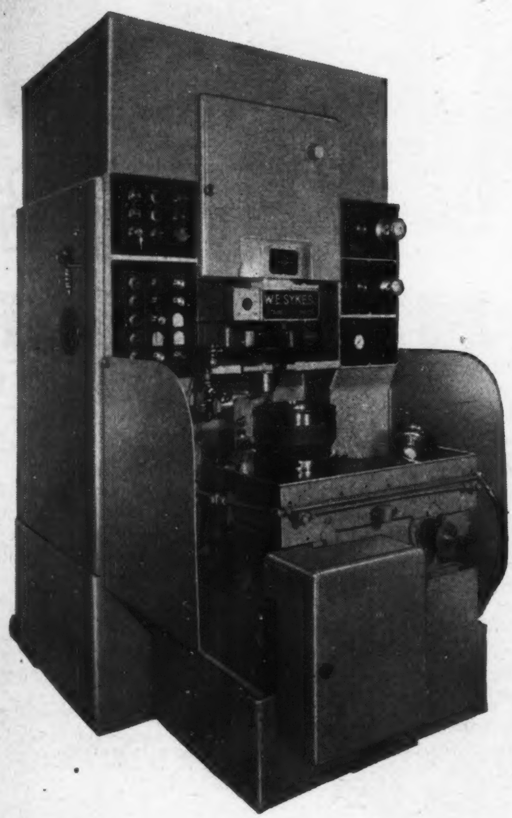
C2

EXPERIMENTAL SPRINGS?
Don't grope here . . .
Select your springs here
No. 1217
One gross
Assorted Springs
45/-
No. 1200
Three dozen Assorted Light Expansion Springs, suitable for carburettor control, etc. 15/-.
No. 760
Three dozen Assorted Light Compression Springs. 1" to 4" long, 22 to 18 S.W.G., 1/4" to 1/2" diam. 7/6.
No. 98A
Three dozen Assorted 1" to 4" long, 1/4" to 3/8" diam., 19G to 15G. 6/6.
No. 757
Extra Light Compression, 1 gross Assorted, 1/8" to 7/16" diam., 1/2" to 2 1/2" long, 27 to 19 S.W.G. 18/-.
No. 753
Three dozen Assorted Light Expansion 1/8" to 1/4" diam., 2" to 6" long, 22 to 18 S.W.G. 12/-.
No. 758
Fine Expansion Springs. 1 gross Assorted 1/8" to 3/8" diam., 1/2" to 2" long, 27 to 20 S.W.G. 18/-.
That spring you want . . . in a hurry . . . where is it? Pick what you want, when you want it, from TERRY'S BOXES OF ASSORTED SPRINGS—our fine range of small boxed assortments of experimental springs. We can show you only a few from the range here. Send a postcard for our full list—and if ever you're stuck with a spring problem send it along to our Research Department—they'll gladly help you out.
Have you a Presswork problem?
If so, the help of our Design Staff is yours for the asking.
TERRY'S
for SPRINGS
Really interested in Springs? "Spring Design and Calculations" 10th Edition tells all—post free 12/6.
Cut Production Costs with Terry's Wire CIRCLIPS. We can supply immediately from stock — from 1/8" to 1/2".
Looking for good Hose Clips? Send for a Sample of Terry's Security Worm Drive Hose Clip and price list.
HERBERT TERRY & SONS LTD.
Redditch, Worcs.
(Makers of Quality Springs, Wireforms and Presswork for over 100 years.)

V 10 B

Talk to Sykes about the V1OB . . .

for medium batch production



V10B Vertical Gear Generators are available in Semi-Automatic models for the medium or large batch production of Internal or External gears. A pre-set cycle and interlocked hydraulic work clamping relieves the operator of all attention except for component loading. Automatic cutter 'lift' or 'stop at top of stroke' allows simple foolproof loading of Internal gears and permits optimum cutting speeds to be used.
Infinitely variable speeds and feeds. Switch selected 1, 2 or 3 cut hydraulic Infeed. Autocycle, including rapid saddle traverse and adjustable drop-off point. Visual indication of progress of cycle. Sizing control switch for rapid checking after cutter change. Constant, pre-set, hydraulic Infeed, independent of component diameter. Adjustable off-set saddle for maximum feed rates. PLUS . . . Automation; by coupling into conveyor type system. Alternatively a number of machines can be linked into a continuous production line.

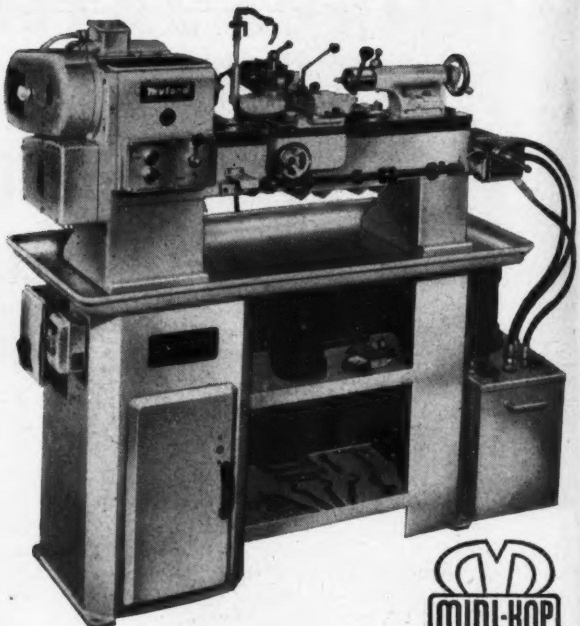
If you would like to know more about the unique features of the V10B Semi-Auto models, write for a copy of brochure P18/60.

SYKES

W. E. SYKES LIMITED · STAINES · MIDDLESEX · ENGLAND

and associated companies:
Sykes Tool Corporation Ltd., Windsor, Ontario, Canada. Sykes Machine & Gear Corporation, Detroit, Michigan, U.S.A. W. E. Sykes Ltd., Mascot, Sydney, NSW, Australia.

a high-speed hydraulic copying lathe for small parts



MINI-KOP

Myford MINI-KOP

SERIES 1A

Specifically designed for copy-turning small components up to 1 inch diameter. This is a fully hydraulic machine with hardened bed . . . hydraulic carriage motion has instantly variable feed-rate control and fast traverse in either direction . . . alternative reproducer approach angles . . . and many other features to facilitate small component copying.

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Will reproduce steps as small as 0.0005 inch.
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Spindle speeds to over 4,000 r.p.m.
Costs little more than many copying attachments.

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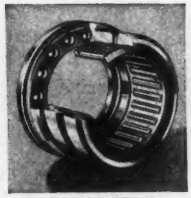
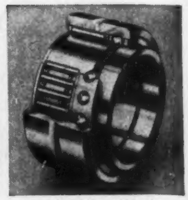
Ina Needle Cage


Ina Needle Bearing


Ina Combined Bearing (NKX Series)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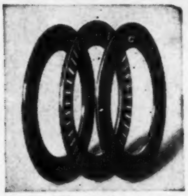
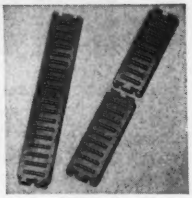

Ina Thrust Bearing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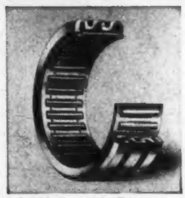
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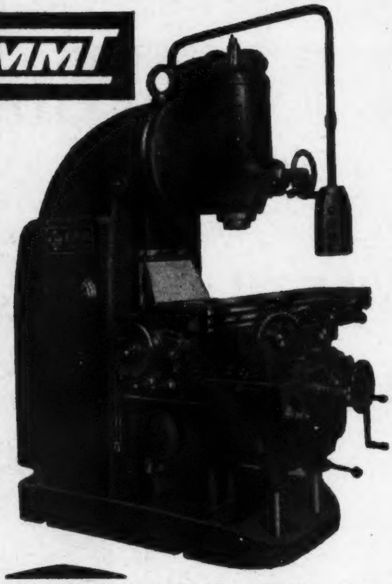

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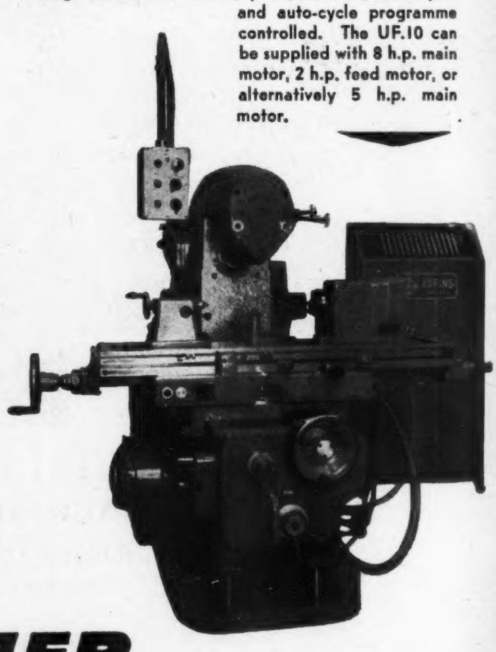

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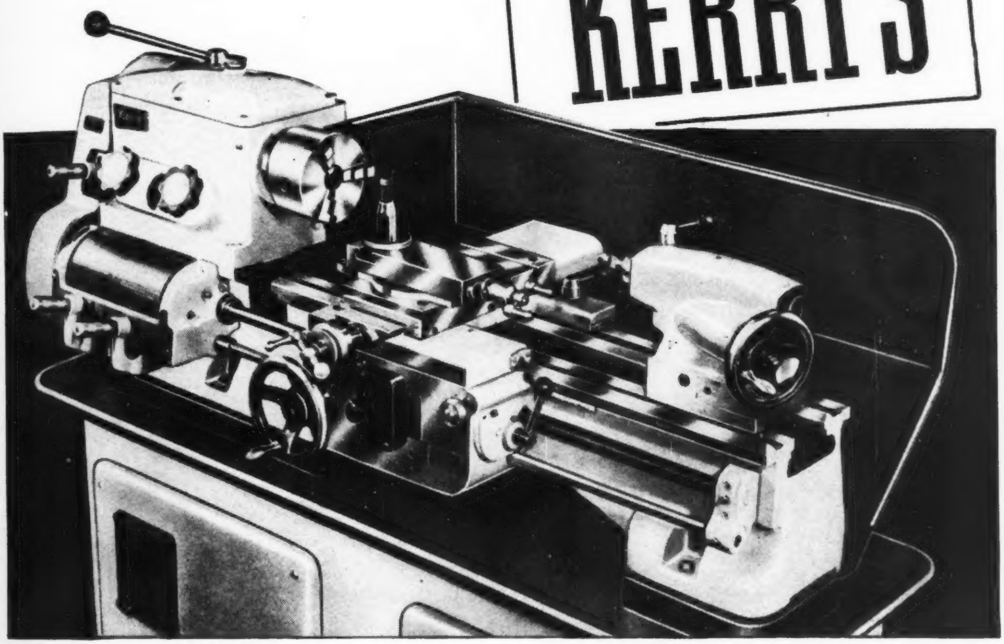
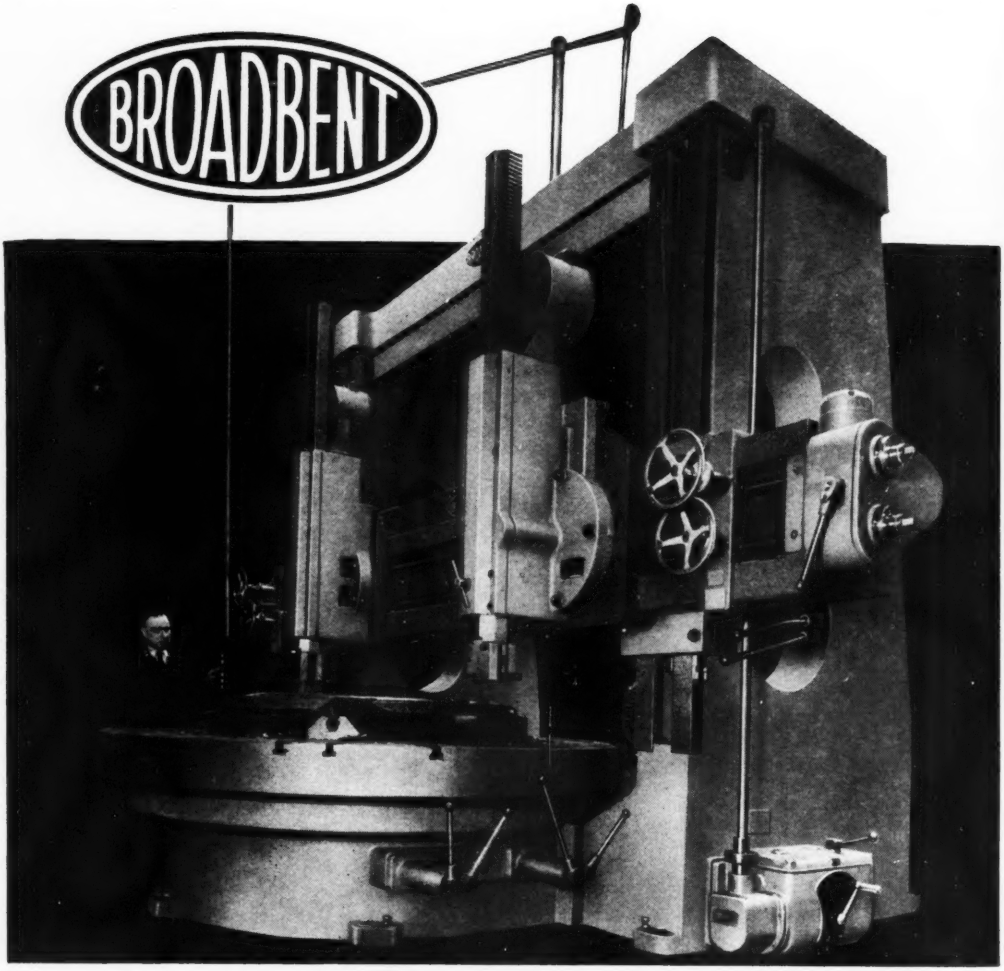
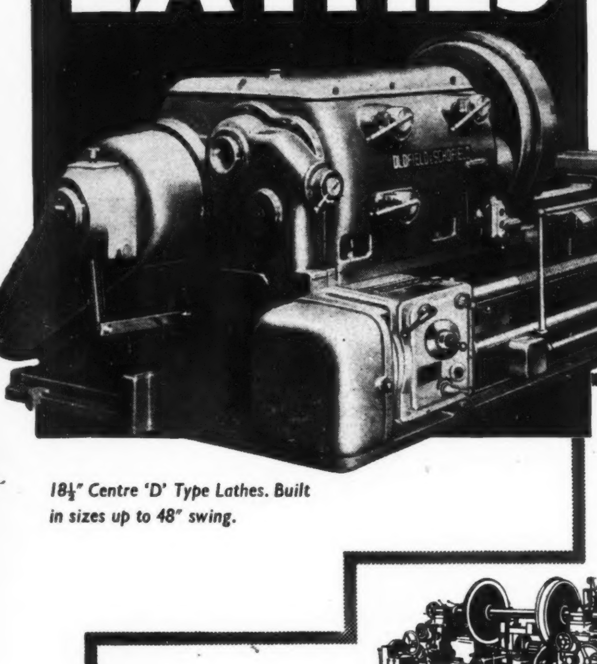
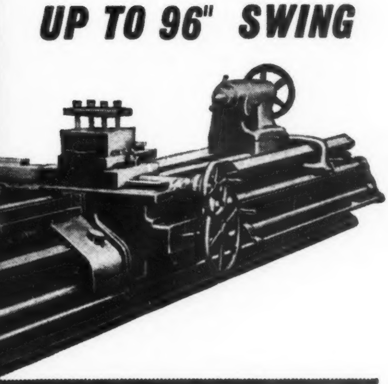



BROADBENT

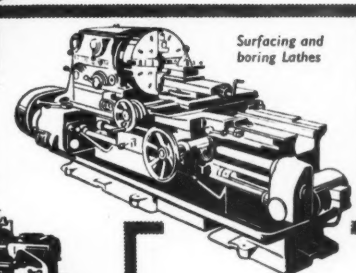
Heavy Duty LATHES

O&S

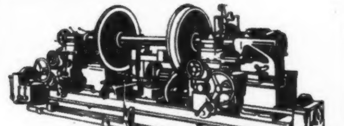
UP TO 96" SWING

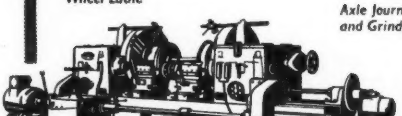
18½" Centre 'D' Type Lathes. Built in sizes up to 48" swing.



Surfacing and boring Lathes



Axle Journal Turning and Grinding Machines



Heavy Duty Double Wheel Lathe

O & S have for many years manufactured a wide variety of heavy lathes which have earned for the company a fine reputation for precision engineering and first class craftsmanship. The range includes Surfacing and Boring Lathes up to 96" swing, Brake Lathes, Axle Lathes, railway carriage and waggon wheel lathes, axle journal turning and burnishing lathes etc., all embodying the latest developments in modern lathe design.

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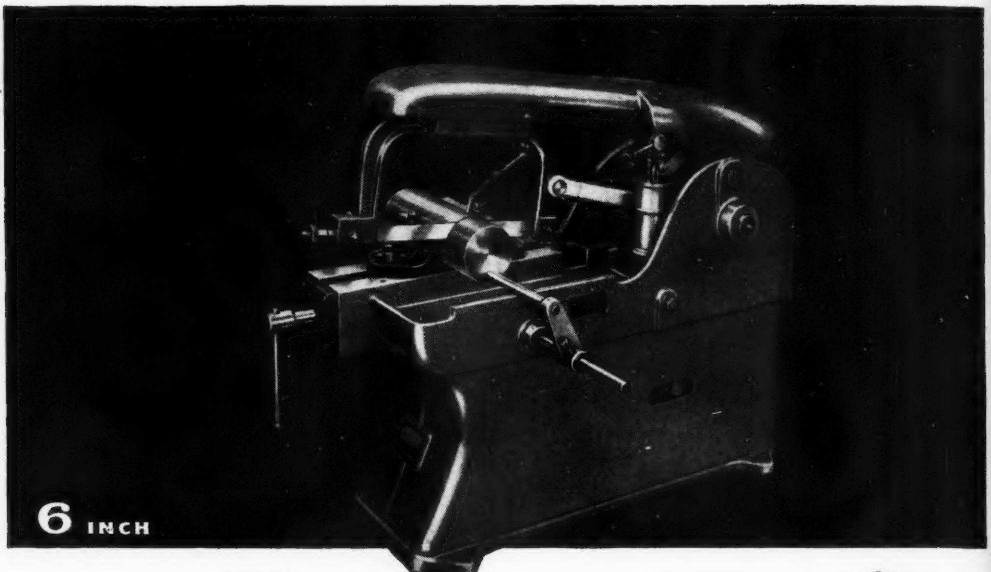

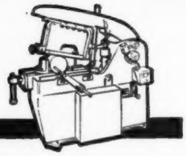

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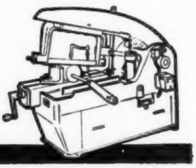

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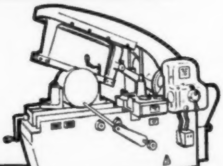

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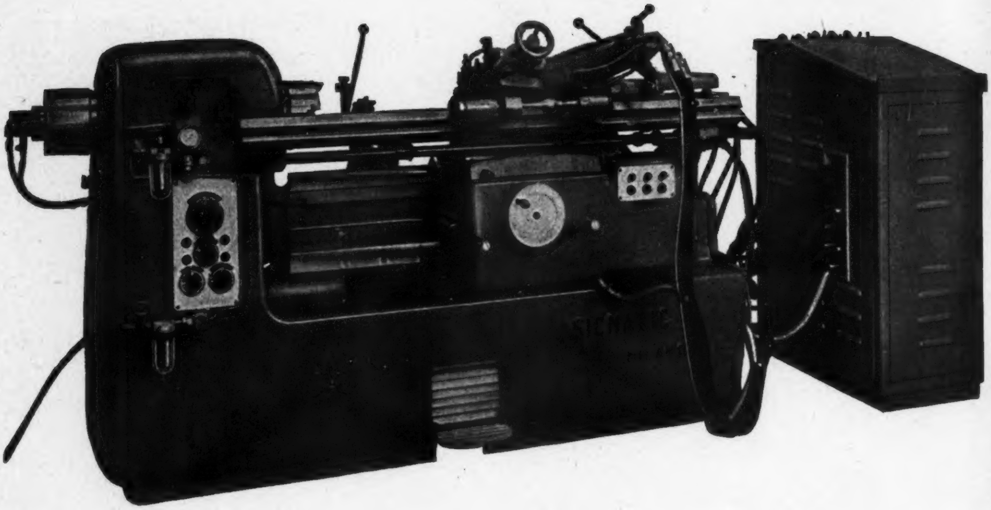

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Uses template or existing component.
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Basic price under £2,000.

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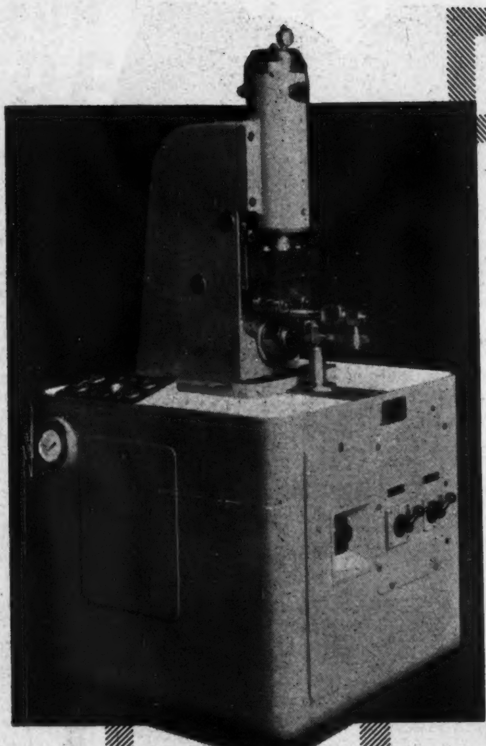

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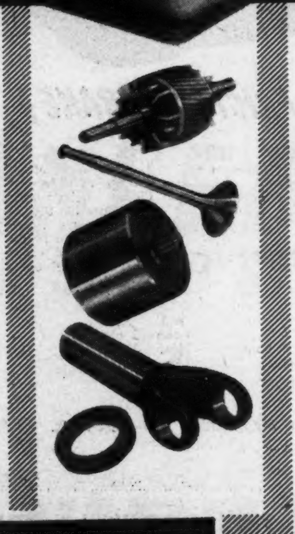

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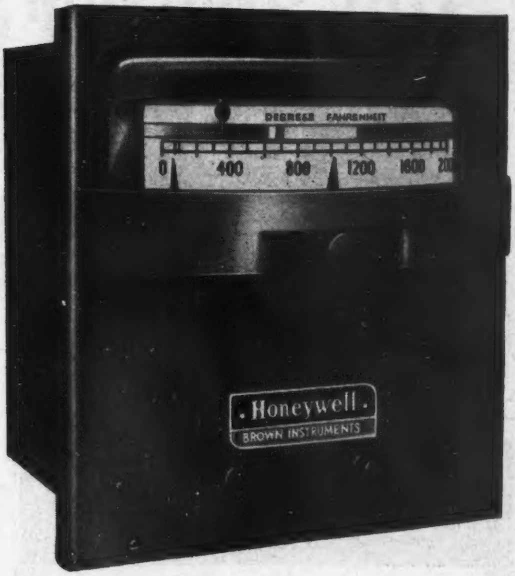

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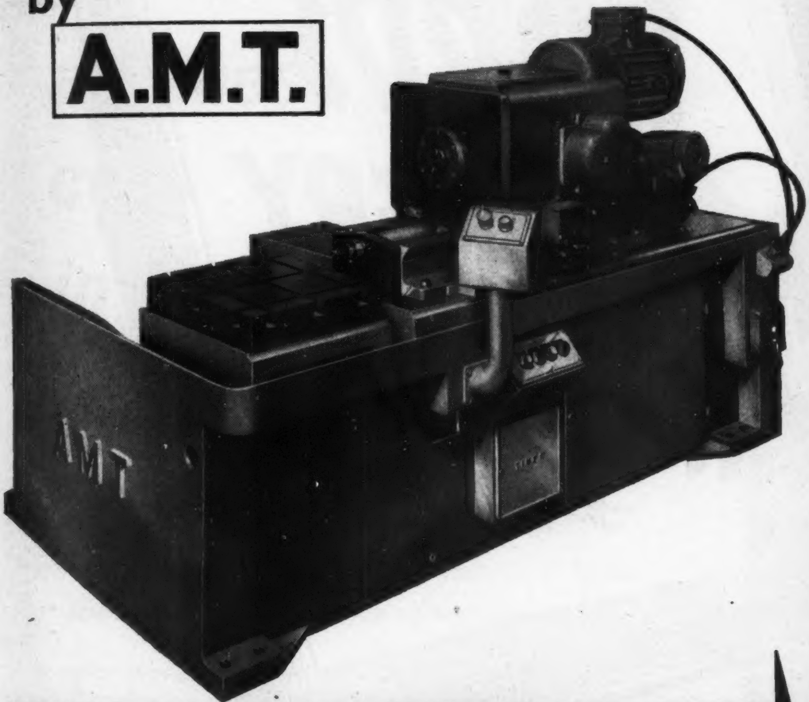

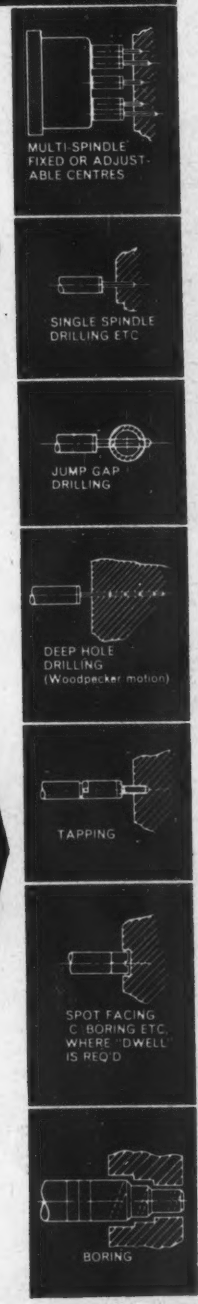

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Here is a "multi-cycle" machine within the price range of a single-operation production machine which has been developed especially for batch or quantity production. It is available in three sizes—2 h.p., 5 h.p. and 10 h.p. for horizontal or vertical application.

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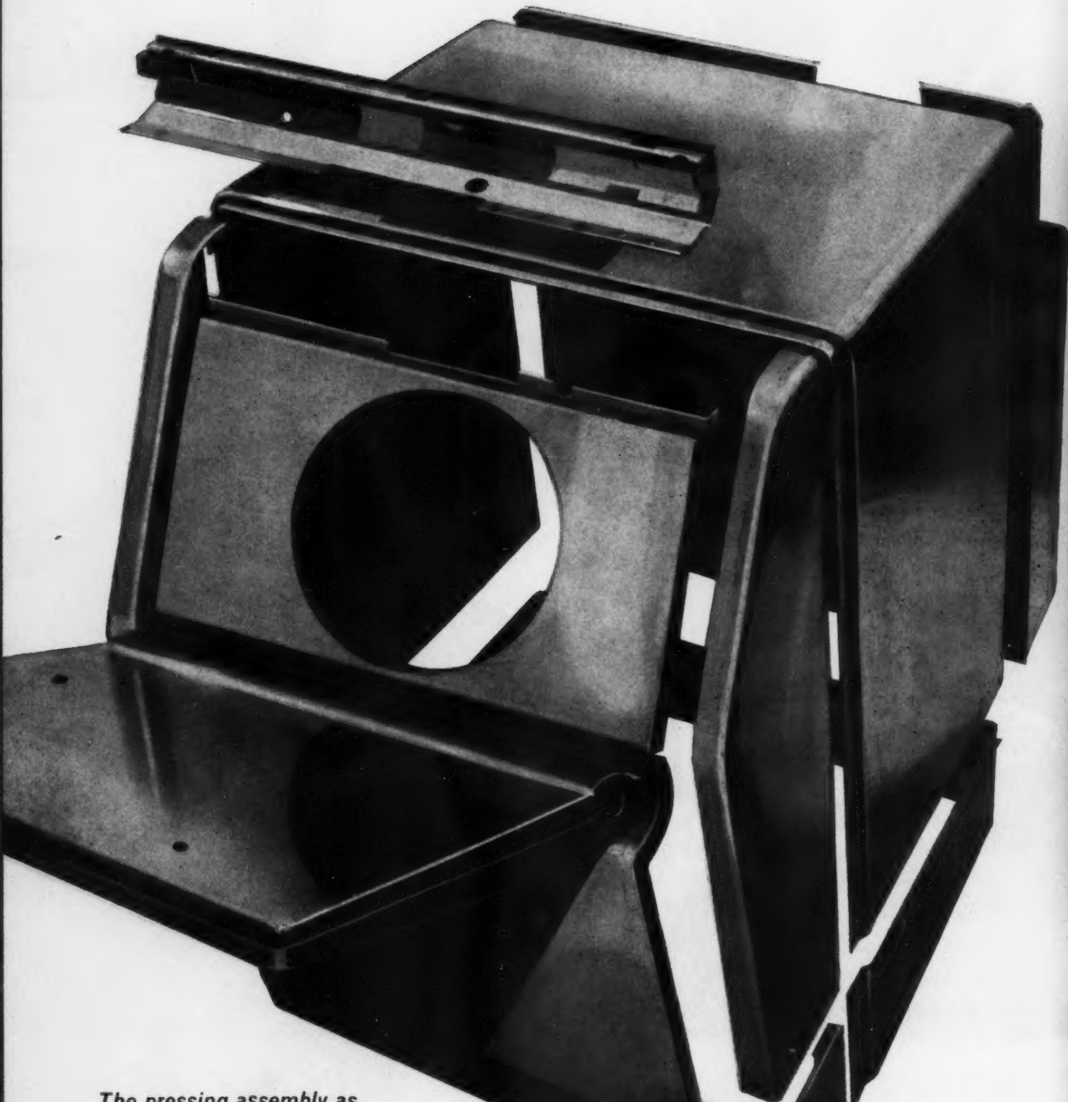
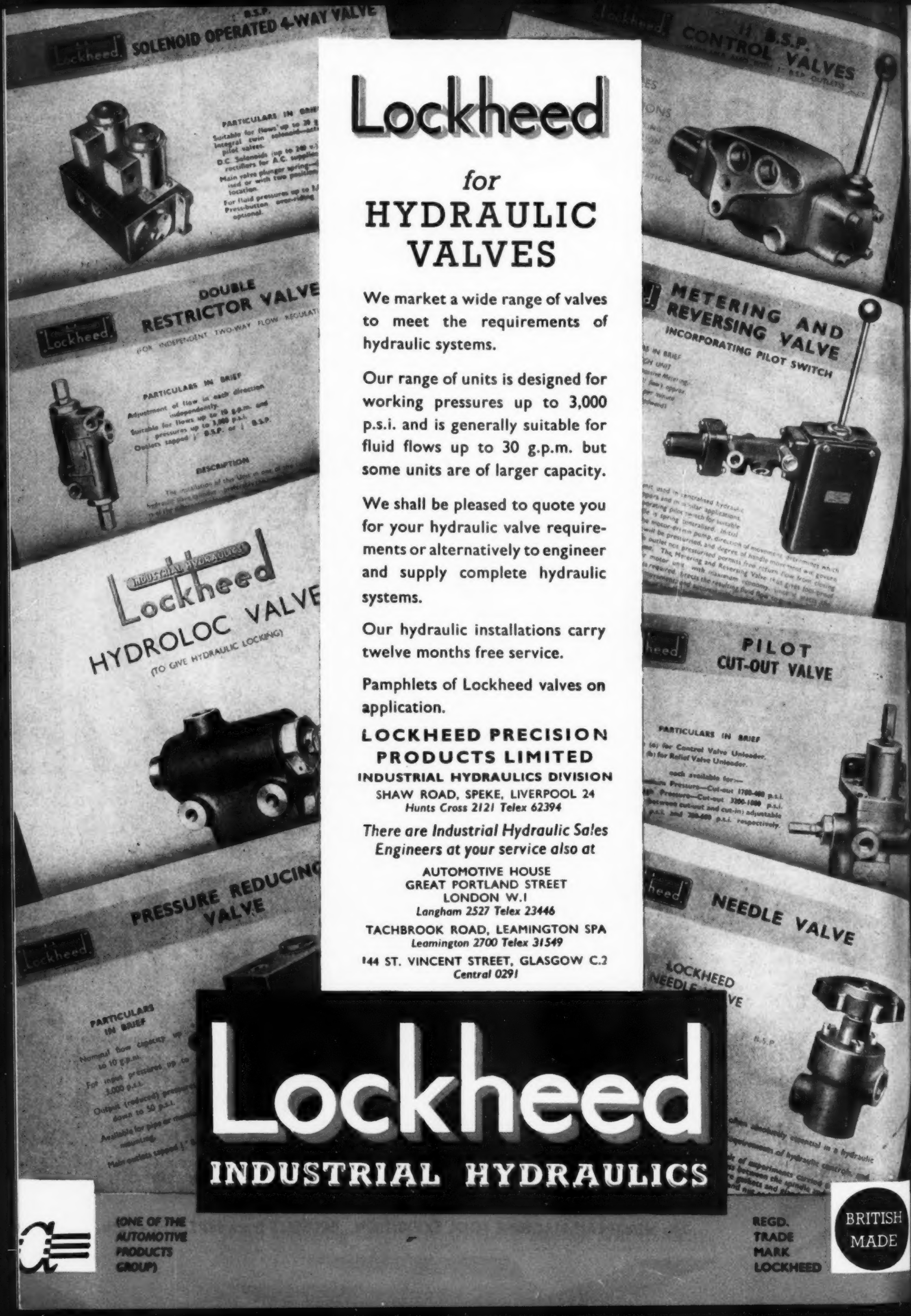
PRESSING FOR PRODUCTION ...



The pressing assembly as produced by HOOVER Ltd for their KEYMATIC Washing Machine in their Merthyr Tydfil Press Shop illustrated on the opposite page.



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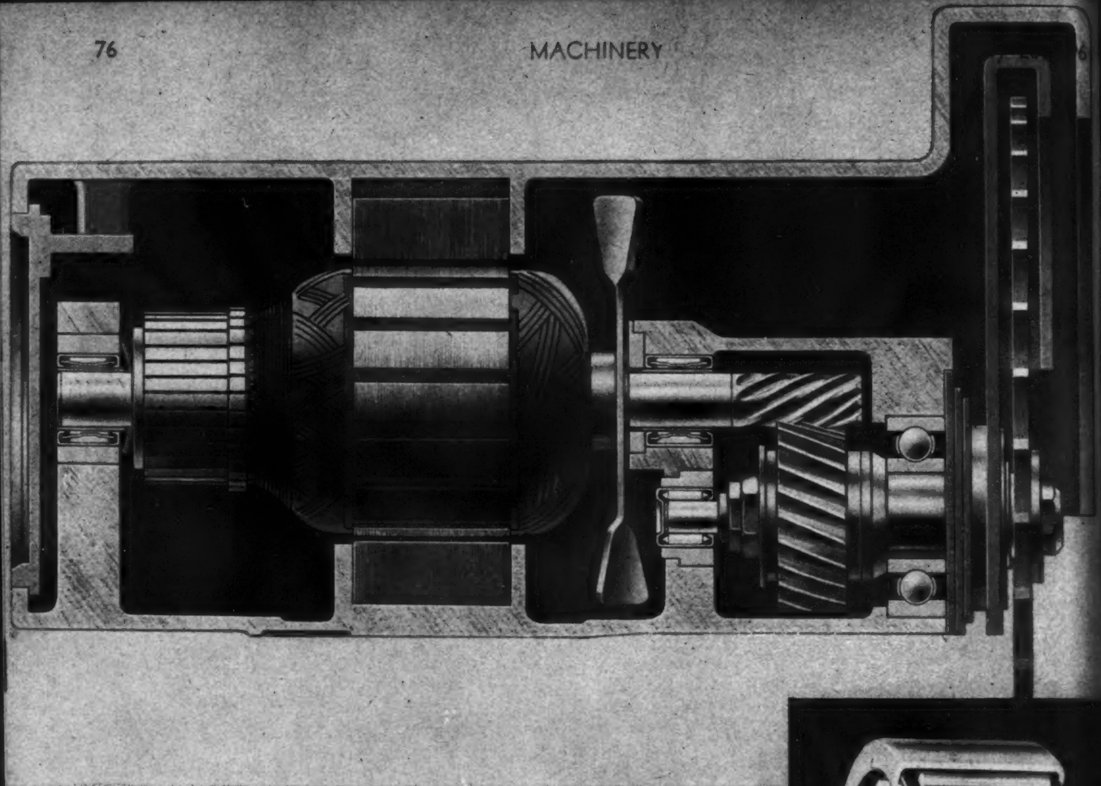

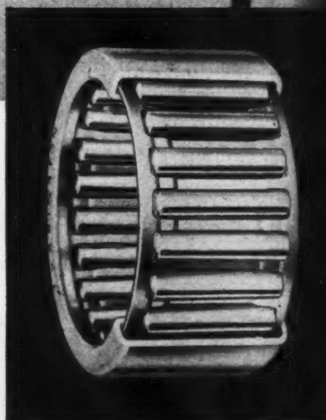

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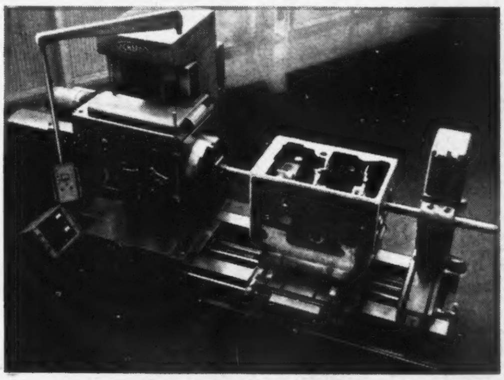
Illustrated right is the latest RICHARDS Table type Horizontal Boring, Facing, Milling, Drilling and Tapping machine, built in a range with Traversing Spindle diameters 2½in. to 8in.



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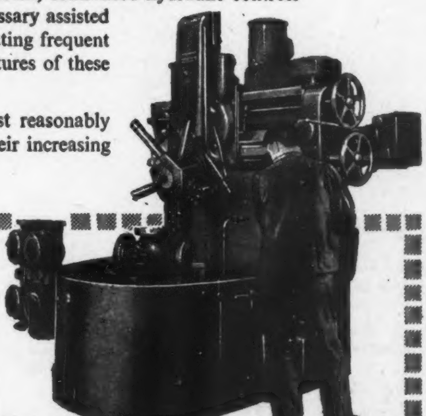
If your business requires the boring and turning of medium to large castings and forgings or similar components, and you do not use Webster and Bennett Boring Mills, it's highly probable your competitors do.

In that case, they'll be getting the benefit of lower overheads, because on the bases of capital costs and running costs there are no other machines quite as economical.

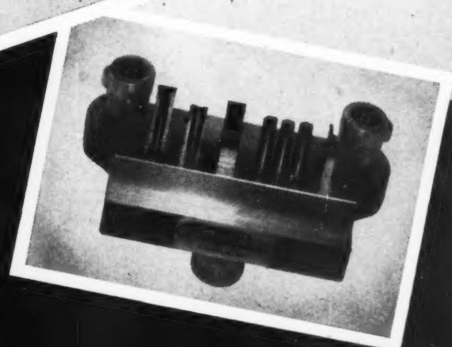
Powered for carbide tooling and high metal removal rates; centralised hydraulic controls for operating convenience; easy reservicing when necessary assisted by unit construction; self-compensating clutches obviating frequent adjustment for wear, are some of the outstanding features of these machines.

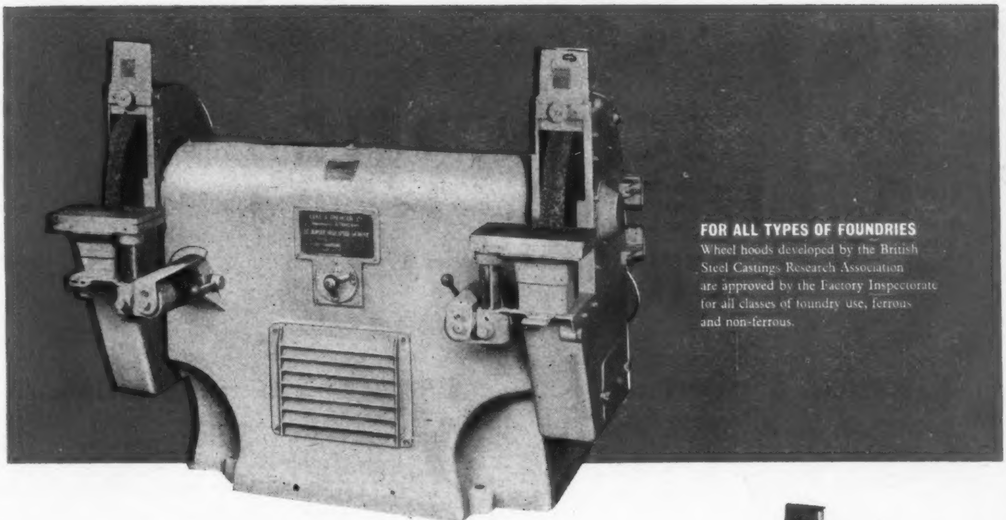
Add to this the fact that they are probably the most reasonably priced machines of their kind, and the reasons for their increasing demand become clear.



The illustration shows one of the battery of Webster and Bennett Boring Mills installed in the London Works of Dewrance & Co. Ltd., facing, turning, boring and screwing 5" valve bodies in a floor to floor time of 66 minutes.

WEBSTER & BENNETT LTD., COVENTRY, ENGLAND





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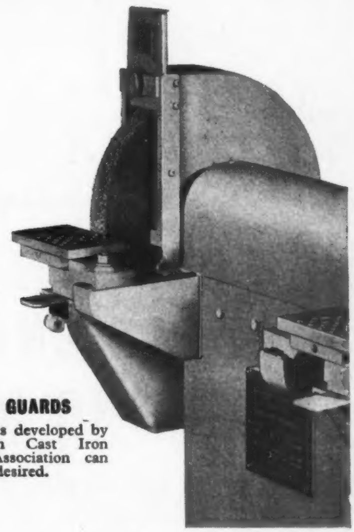
Luke & Spencer manufacture a large range of pedestal and swing frame grinders which incorporate the latest developments in efficient dust extraction.
Single or double ended pedestal grinders can be supplied with wheels ranging from 12 inches to 36 inches diameter.

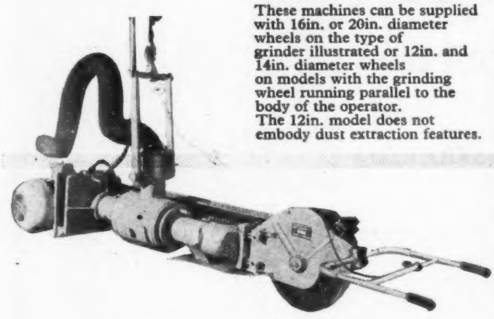


B.C.I.R.A. GUARDS

Wheel hoods developed by the British Cast Iron Research Association can be fitted if desired.

SWING FRAME GRINDERS

These machines can be supplied with 16in. or 20in. diameter wheels on the type of grinder illustrated or 12in. and 14in. diameter wheels on models with the grinding wheel running parallel to the body of the operator.
The 12in. model does not embody dust extraction features.



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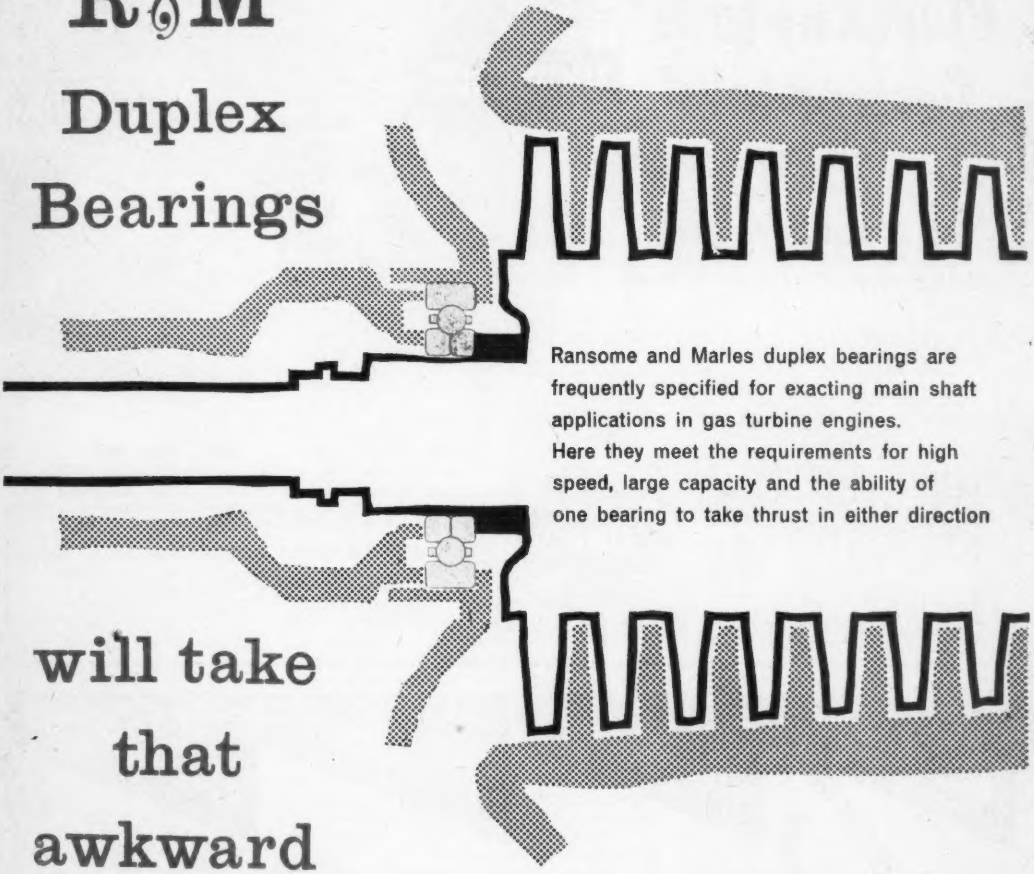
R&M Duplex Bearings



Ransome and Marles duplex bearings are frequently specified for exacting main shaft applications in gas turbine engines.
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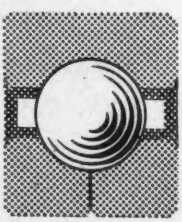

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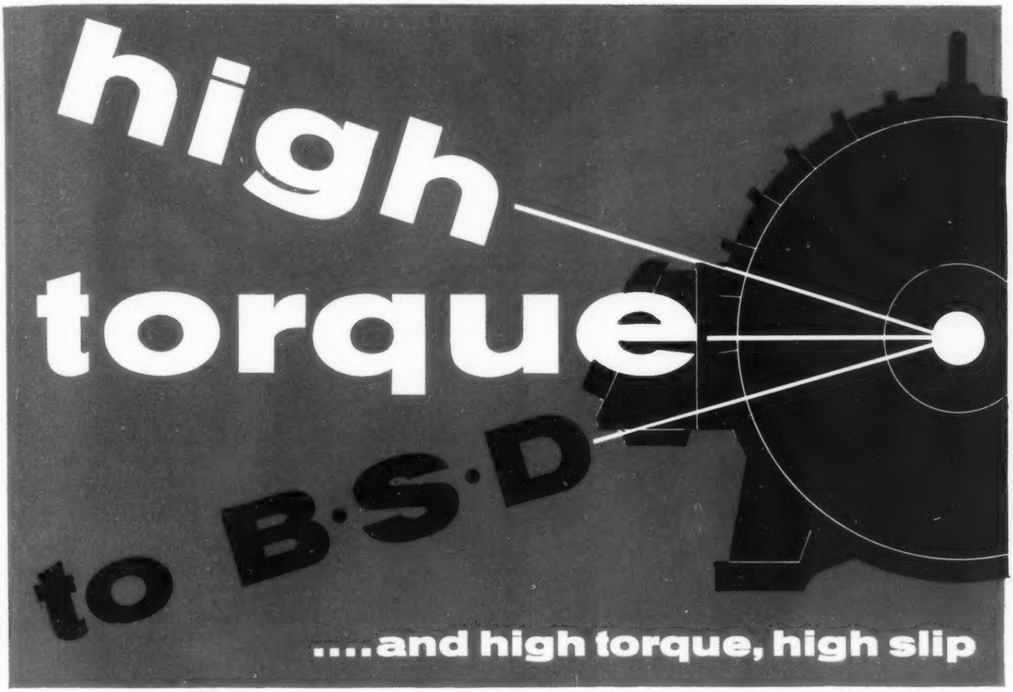

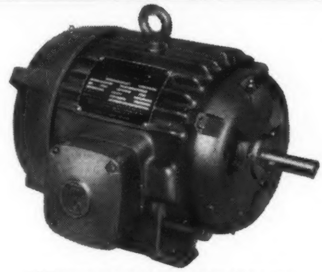

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Abstracts of Principal Articles

The Production of Hydraulic Pit-props P. 180

In this second article, concerned with some of the methods employed by Dowty Mining Equipment, Ltd., Ashchurch, Glos., for producing their Mark IV Duke hydraulic pit-props, further examples of operations performed in the preliminary fabrication section are discussed. These operations include the swaging of the outer tubes, on a special-purpose Dowty hydraulic machine, and the arc welding of the pump cylinders to the piston heads. The methods and equipment employed in a special department devoted to the assembly and testing of breather valves and relief valves are also considered. (MACHINERY, 99—26/7/61.)

The Mechanics of Chip Formation.. P. 193

This article is an abstract of a paper read before the American Society of Mechanical Engineers and includes some of the results of experiments which were carried out in investigation of the mechanics of metal-cutting with the aid of a new technique. The equipment employed includes a high-speed cine camera which provides for rapidly recording various data while cutting is taking place. This data is subsequently analyzed. The experiments were carried out on a shaping machine, on which the conventional procedure was "reversed," that is, the tool was mounted on the work-table and the workpiece was secured rigidly to the reciprocating ram. Various materials were machined, including cold rolled steel, hot rolled steel, wax, brass and aluminium, and valuable data was obtained in connection with deformation of the work in advance of the cutting edge, the growth of cracks in the work, and the build-up of material at the tool face. The high-speed film revealed that the tool face and chip flow bear some resemblance to the bow of a ship ploughing through water, and it is suggested that an analogy with hydrodynamic flow may be plausible. (MACHINERY, 99—26/7/61.)

The East German Institute of Machine Tool Engineering .. .. P. 202

After a brief reference to the organization of the East German machine tool industry, and the scale of output, this article gives some details of the Institute of Machine Tool Engineering, and the work undertaken. This Institute has recently occupied a new building which includes a large test hall with facilities for studying problems likely to arise in connection with the designing and construction of machine tools. The hall has a number of vibration-insulated concrete rafts on which machine tools can be installed for testing, and an extensive range of equipment is provided. Examples of work in progress include the testing of a fine-boring machine, measurement of the stiffness of a guillotine frame with strain gauges, and investigation of the effects of vibration in hydraulic oil on a broaching machine. The influence of the Institute on machine tool design is also discussed. (MACHINERY, 99—26/7/61.)

The Gating of Aluminium Die Castings P. 209

The gating of aluminium alloy die castings determines, more than any other factor of die design, the surface finish and structural soundness which is obtained. A primary aim of gating practice must be to avoid sealing-off vents and overflows in the early stages of filling, since once this has occurred residual air is inevitably trapped within the casting. Gating arrangements which produce this effect are considered, as are the disadvantages caused by curved runners. For aluminium castings, thin section gates should be avoided, and heavier gates, which result in "puddling" of the incoming metal, provide various advantages. Mention is also made of the effects of ribs, and their positions, on the flow of metal in a die. Finally, mention is made of the increasing use of milling techniques to remove runners from castings. (MACHINERY, 99—26/7/61.)

Machine Tools at the Soviet Exhibition P. 217

The second of two, this article describes machine tools on show at the Soviet Exhibition, including a fine boring machine with programme control by punched cards, and a hydraulically-operated indexing fixture. A large 8-spindle, vertical chucking automatic has punched card control of feeds for the individual tool slides. Automatic control of the down-feed is provided on a horizontal-spindle surface grinding machine, and the design of a universal thread-grinder makes it possible to carry out external, internal and taper thread grinding, in addition to form-relief work. A grinding machine for straight and helical spur gears operates on the generating principle. (MACHINERY, 99—26/7/61.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

Progress in Precision

Further advances in many branches of engineering and in other scientific fields will depend to a large extent on the ability to produce components and to measure them with a constantly increasing degree of accuracy. Very important progress has been made in these directions during recent years and with progressive refinements in techniques of measurement and comparison, the form of the ultimate standard to which all dimensions must be related has assumed greater significance. Obviously, in view of the multiplication of errors that inevitably occurs at the various stages necessarily involved in the comparison of the workpiece dimension in the machine shop or the inspection room with the ultimate standard, it is most desirable that the latter should not itself be subject even to minute changes. Partly for this reason, a satisfactory alternative to the material standards of length that have served hitherto has long been sought. As is well known, much work has been done over a long period of years to determine the feasibility of employing a wavelength of light for this purpose, and for the metre such a definition was adopted last year. As a result, the metre is now defined by means of "the radiation that corresponds to the transition between the levels $2p_{10}$ and $5d_5$ of the atom of krypton 86 and by agreement is equal to 1,650,763·73 times the wavelength of this radiation."

This natural standard is indestructible, can be reproduced in laboratories in any part of the world, and is of assured stability. It is stated, moreover, that its adoption has resulted in an important gain in precision, since the degree of uncertainty has been reduced in the ratio of at least 10:1. To enable the potential advantages of the new standard to be implemented, special equipment has been designed and constructed by a company of world reputation in the field of metrology of the highest precision, in collaboration with the International Bureau of Weights and Measures.

This equipment, which it is hoped to describe in some detail in a future issue of MACHINERY, will be installed and operated under conditions that will permit the meticulous measurement and control of environmental conditions so essential if the desired degree of precision is to be achieved. Thus, the equipment will be enclosed when in operation in an airtight cylinder within a room, and it is hoped to control the temperature in the room to 0·01 deg. C. and in the cylinder to 0·001 deg. C. In view of their influence on the wavelength of the light source, moreover, there will also be provision for very accurate determination and regulation of such factors as the humidity, pressure, and composition of the air within the cylinder.

Where such refinements of measurement are sought, it is obviously essential to ensure that the results are not affected by the proximity of the operator and that the minimum of reliance is placed on his senses for purposes of adjustment and observation. For these reasons, the operator will be housed in an adjacent room which will be heavily insulated and an elaborate system of remote control and indication is provided to ensure, as far as possible, that readings obtained will be independent of his judgment. The sensitivity of the equipment is greatly enhanced by the use of photo-electric—rather than optical—microscopes, which enable a scale line to be located within only minute limits of error, or the displacement of such a line from the microscope axis to be determined with great precision. It is understood, moreover, that provision has also been made for counting interference fringes photo-electrically when measurements are being made by interferometry, to eliminate another source of human error. In this connection it has been stated that it will be possible to obtain readings to 0·01 of a fringe, and mention has even been made of 0·001 of a fringe. To enable the sensitivity implied to be better appreciated, it may be pointed out that 0·01 of a fringe represents a distance of approximately 0·24 micro inches.

Of especial interest to the engineer concerned with the design and production of high precision machines and mechanisms are certain of the mechanical problems that have been encountered in connection with the construction of the equipment, and the manner in which they have been solved. Thus, to obtain very sensitive movement of a slide for final positioning, magneto-striction of a nickel bar is employed, the amount of the magnetizing current applied being under the control of the operator. In another part of the equipment it was necessary to provide for very accurate angular adjustment of a compensating plate for the purpose of varying the light path when taking measurements by interferometry. With the mechanism employed, the torques exerted

(*Continued on page* 231)

The Production of Hydraulic Pit-props

Methods Employed by Dowty Mining Equipment, Ltd., Ashchurch, Glos.

By S. C. POULSEN, Associate Editor

AN EARLIER ARTICLE IN MACHINERY, 99/82—12/7/61, was concerned with some of the methods employed by Dowty Mining Equipment, Ltd., Ashchurch, Glos. (a member company of the Dowty Group) for producing typical sub-assemblies for their Mark IV Duke hydraulic pit-props. Here, some further examples of work carried out in the preliminary fabrication section are considered.

SWAGING THE OUTER TUBES

In preparation for "swaging" the outer tubes —as the operation of flaring the upper ends, to receive the split bearing-rings, is termed—the end of each is chamfered on the Lodge & Shipley lathe shown in Fig. 1. Mounted on the saddle is a fixture incorporating vee rests, in which the work is held by air-operated latch-type clamps. For loading, each of the arms *A* is swung to the rear, by an associated pneumatic ram, so that the latches can be raised. A tube is placed on the vee rests and backed against an end-stop, and the latches are returned to the working position. When air is admitted to the cylinders, by means of the manually-operated valve *B*, the arms *A* are swung forward, and a roller on each arm moves on to an inclined face on the latch, so that the latter is thrust downwards. Each latch is provided with a pivoted equalizing pad, to distribute the clamping pressure.

A high speed steel cutter is mounted on the head-stock spindle, which is run at 196 r.p.m., and the work is advanced against it by traversing the saddle by hand feed, the movement being limited by a fixed stop. This stage is completed in 1½ min. per tube, and the angle of chamfer is such that when the swaging operation has been carried out, the end-face is flat. As each tube is unloaded, it is placed on the gravity roller-conveyor seen in Fig. 1 for delivery to a 25-kW. Delapena induction heating machine, on which the end to be swaged is first annealed. The annealed length must be accurately controlled, otherwise the tube tends to bulge behind the flare during the swaging operation.

In Fig. 2 is shown a close-up view of the working zone of the induction heating machine, the cycle of which is linked, automatically, to that of the swaging machine. Initially, the movement of the tube along the conveyor is arrested by the air-operated stop *C*, which is actuated by the ram *D*. This stop serves to locate the work in the required longitudinal

Fig. 1. This Lodge & Shipley lathe is used for chamfering the outer tubes, in preparation for swaging, before they are passed to an induction heating machine, seen in the background

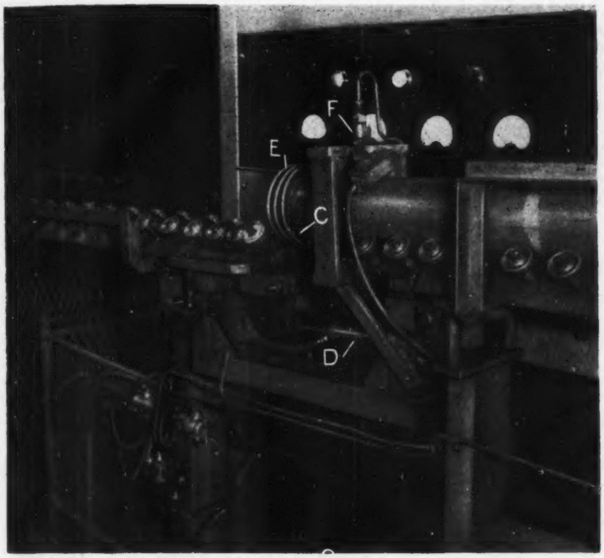

Fig. 2. In this close-up view of the Delapena induction heating machine employed for annealing the tubes may be seen the inductor-coil, stop, and conveyor. The cycle is automatically linked to that of the swaging machine

position, in relation to the inductor-coil *E*. When the operator at the swaging station starts the automatic cycle of his machine, that of the induction heating machine is also initiated. The work is then clamped by two pneumatic rams, one of which may be seen at *F*, the inductor coil is energized, and the stop *C* is swung clear.

After a heating period of 38 sec., the current is switched off, and the rams *F* are raised to release the work. As the heated tube is carried clear of the coil, on a continuation of the roller conveyor, it trips a micro-switch to return the stop *C* to the working position, in readiness for the next cycle. At the end of the roller conveyor there is a cooling rack, shown in Fig. 3, which serves the swaging machine. When the heated tube reaches the final section of the roller conveyor, it trips another micro-switch, and a section of conveyor is tilted sideways, and returned, by the pneumatic ram *G*, so that the tube is delivered into the upper end of the cooling rack. As may be observed, the rack is of a double-incline type, and the lower section is arranged to deliver the cooled tubes directly to the swaging machine, as shown in Fig. 4. This view also shows the turn-over portion *H*, of the roller conveyor, and the ram *G*.

As each tube reaches the bottom of the cooling rack, it rolls on to an air-operated lift platform *J*, Fig. 4, whereby it is raised into line with the swaging mandrel *K*, of the machine. The upward movement of the platform is selected by the opera-

Fig. 3. This cooling rack, into which the heated tubes are delivered, serves the swaging machine. The final section of the roller conveyor is tilted sideways, by the pneumatic ram *G*, to discharge the tubes into the rack

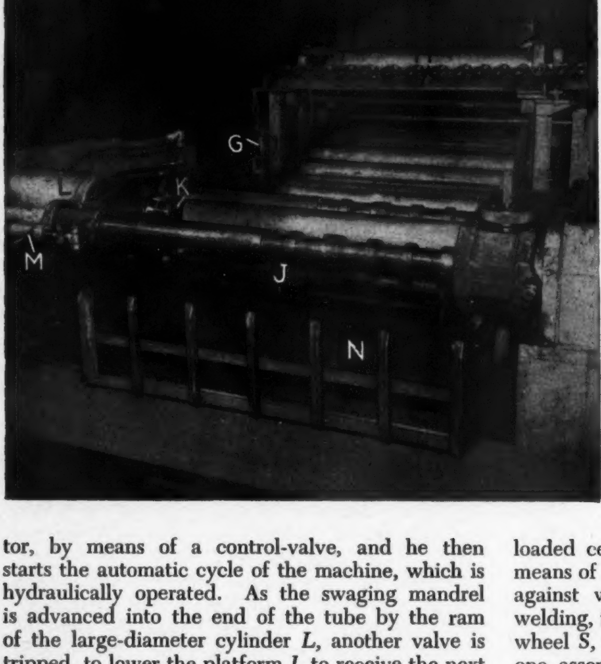

Fig. 4. This view of the swaging machine, in which the swaging mandrel is indicated at *K*, shows the arrangement for delivering the tubes from the rack, and raising them into position by means of the lift *J*

tor, by means of a control-valve, and he then starts the automatic cycle of the machine, which is hydraulically operated. As the swaging mandrel is advanced into the end of the tube by the ram of the large-diameter cylinder *L*, another valve is tripped, to lower the platform *J*, to receive the next tube. When a predetermined swaging pressure is reached, the mandrel *K*, the cross-head on which it is mounted, and the main ram, are retracted, by a pair of return-cylinders *M*. As the swaged tube falls clear of the mandrel, it is delivered into the tray *N*, at the front of the machine, whence it is removed and placed in a stillage. Prior cooling of the work, it may be noted, ensures that properties of the material, reduced by annealing, are substantially restored by the cold deformation. The machine was designed and built by the company.

WELDING THE PUMP CYLINDERS

Another operation that is performed in the preliminary fabrication section is the arc welding of the pump cylinders to the piston heads. In the side of each welding booth, there is a 2-station turn-table of the design shown in Fig. 5, which incorporates a plate *P* that serves as a partition. While one fixture is in use, within the booth, the other, outside, is accessible to a "chipper loader". The piston head is located on the circular table *Q*, by a spigot that engages the non-return valve bore, and the cylinder is inserted in a recess in the head. A shouldered plug, placed in the cylinder, is engaged by the spring loaded centre *R*, which is raised, for loading, by means of a lever. The relief valve bore is protected against weld spatter by a loose plug. During welding, the work is rotated by means of the hand-wheel *S*, and as soon as the welder has completed one assembly, he indexes the turn-table to bring the next into position, so that he is able to work almost continuously. At the next stage, the release

Fig. 5. For welding the pump cylinders to the piston heads, 2-station turn-tables are employed. One fixture is loaded while the other is in use, so that welding can proceed almost continuously

Fig. 6. On this simple air-operated machine, the end fittings of the tubular release valve push rods are inserted simultaneously. There are two control buttons, to ensure that the operator's hands are clear of the working zone

valve push rod sleeve is welded, and the work is then thoroughly cleaned.

In the same section, the release valve push rods and the pump connecting rods are assembled and drilled. Each push rod comprises a length of 18 s.w.g., $\frac{7}{16}$-in. diameter steel tube, with pressed-in and spot welded end fittings, which are inserted in the tubes with the air operated equipment shown in Fig. 6. A length of tube is supported in a series of rests, and an end fitting is placed in a hollow mandrel that is arranged in line with the tube, at each end. The mandrel at the left is fixed, whereas that at the right is air operated. To facilitate their entry into the tubes, the shanks of the end fittings are tapered, with a radius at the junction of the shank with the outer portion. When two buttons, seen at the front of the bench, are pressed simultaneously, the two fittings are forced home to the required depth, which is controlled by the travel of the ram. With this equipment, the fittings are assembled to each tube in a floor-to-floor time of 1½ min.

An unusual arrangement of electrodes, as shown in Fig. 7, is provided on the A.E.I. machine employed for spot welding the end fittings to the tubes, with two welds per fitting. The bottom electrode is in the form of a block with two semicircular recesses, and in line with each recess there is a back stop *T*, of the same material as the block. A cylindrical member, arranged transversely, forms the upper electrode. Welding is carried out by inserting the work in one of the semicircular recesses, against the back stop, operating the machine, rotating the work through 180 deg., and again operating the machine, to form the second weld. With the work reversed, end-for-end, and located in the second recess, the procedure is then repeated.

Welding is followed by the drilling of the cross pin hole, at the set-up in Fig. 8. The forked end of the work is located by two tongues in the fixture *U*, and the opposite end, by the back-up block *V*, which is adjustable longitudinally on the bed, to accommodate rods of different lengths.

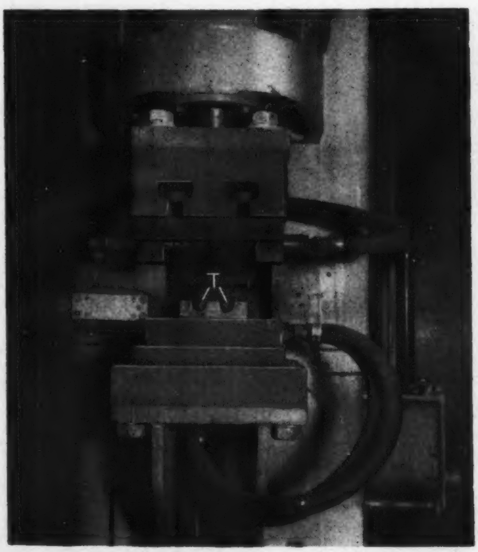

Fig. 7. This unusual arrangement of electrodes on an A.E.I. welding machine is employed for producing the two spot-welds that secure each end-fitting. Each semicircular recess serves to locate one end of the work

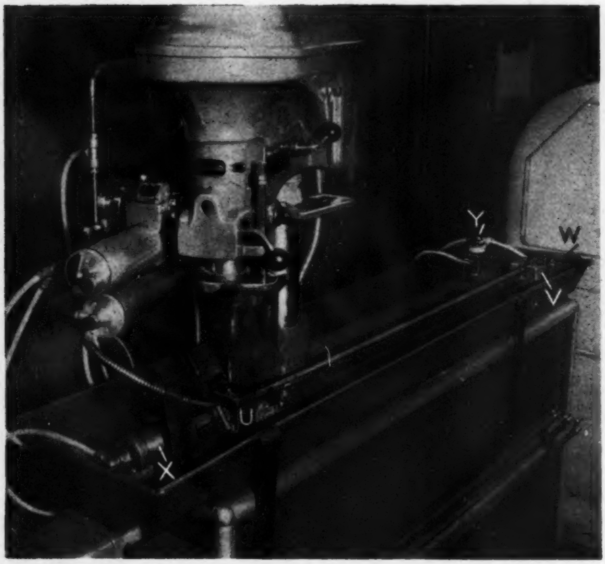

Fig. 8. This special-purpose machine, which is tended by a deaf-and-dumb operator, is employed for drilling the cross pin holes in the push rod end fittings, in a floor-to-floor time of 30 sec. each

When the lever *W*, on the back-up block is depressed, the work is clamped axially by the pneumatic ram *X*, and it is then drilled with the Meddings Pacera head, which is equipped with an air operated automatic feed attachment. The $\frac{3}{16}$-in. diameter high speed steel drill is run at 1,400 r.p.m., and on completion of the drilling cycle, the operator withdraws the ram by depressing the button *Y*. This machine, on which a component is drilled in a floor-to-floor time of 30 sec., is tended by a deaf-and-dumb operator. A generally similar machine, with two Pacera drill heads, is employed for the pump connecting rods.

ASSEMBLING THE BREATHER VALVES

As indicated in the preceding article, some of the more complex sub-assemblies, such as the relief valves and breather valves, are assembled in a department devoted exclusively to this work, separate from the main production lines. Subsequently, these items are issued from the storage area, directly to the appropriate line stations, whereas the basic components required for fabrication are fed to the lines on the overhead conveyor system, in sets.

The breather valves are assembled by a team of four operators, the first of whom de-burrs the machined portions of the die cast bodies, with the aid of a simple fixture. This fixture has a ring, mounted at an angle of about 30 deg. to the horizontal, on a fairly heavy circular base. The valve body is placed with the flange upright in the ring, and rotated, for deburring the peripheral sealing ring groove, and with the flange flat in the ring, resting on an internal shoulder, for de-burring the edges of the closure plate recess in the top of the cup. A similar fixture is used by the next operator, who assembles the filter gauze round the neck of the cup, and secures it with a short length of dovetail section rubber, which is pressed

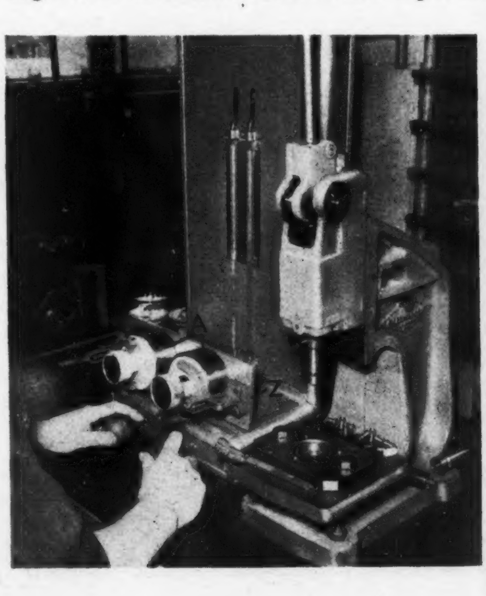

Fig. 9. With this rig, the breather valve sub-assemblies are checked, two at a time, for low pressure reseating characteristics. The pressure applied is indicated on the water column manometer tubes

Fig. 10. The equipment here shown is employed to facilitate the assembly of the relief valves. The special tool seen in the operator's hand serves to locate the valve seat while the body is screwed on to the plug

into a corresponding undercut recess, to trap the turned-in edges of the gauze.

The third operator places the lead ball in the cup, inserts the closure plate in the recess, and rolls over a lip surrounding the recess, to retain the plate. This operation is performed on a bench drill, and the tool is provided with three rollers, inclined at 45 deg. to the vertical. The same operator inserts the rubber valve-seat ring, and snaps the ring seal into the peripheral groove. At the next station, the fourth operator pushes the valve-seat ring home, inserts the ball, spring and plug, and temporarily retains these items in the body by means of a right-angled claw, the shank of which is inserted in the retaining-bolt hole.

With the components temporarily retained in this manner, the valve sub-assemblies are checked, two at a time, on the rig shown in Fig. 9. To facilitate loading, and to simulate working conditions, the fixtures are mounted on a hinged plate Z, which is initially horizontal, with the fixtures upright. Each fixture represents the upper end of the prop inner tube, and comprises a cup A, the bore of which is closed by the peripheral ring seal. The assemblies are secured by toggle-action clamps, and with the fixtures loaded, the plate Z is swung through 90 deg., to the position shown, so that the lead balls roll off the valve stems, thus allowing the valves to close under spring pressure. In service, it may be noted, this closure ensures that the hydraulic fluid cannot escape when the props are laid horizontally.

LOW-PRESSURE SEATING TEST

When the loaded fixtures have been moved to the testing position, the spaces within the cups are pressurized with air, to 8 oz. per sq. in., by means of the rubber bulbs seen at the front

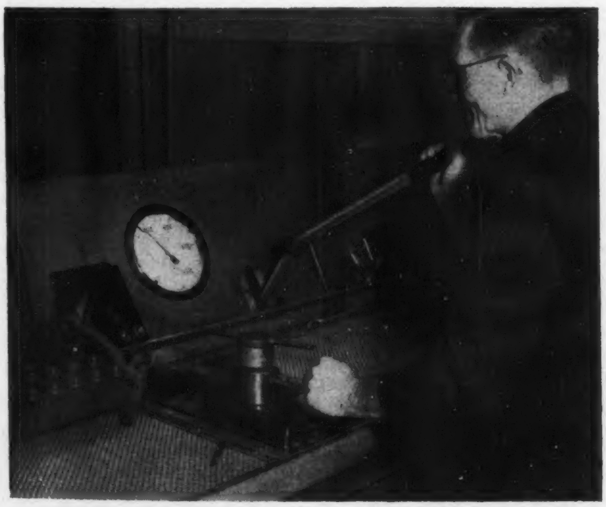

Fig. 11. On this hydraulic rig, the assembled relief valves are set to release at 3,655 lb. per sq. in., ± 40 lb. per sq. in., and are subsequently tested for re-seating, by applying pressure with the hand pump

of the rig. Meanwhile, the pressure applied is ascertained from a water-column manometer tube associated with each cup. When the required pressure is reached, and the bulbs are released, it is maintained by non-return valves. Any leakage in either of the valve sub-assemblies under test is then indicated by a fall in the level of the corresponding water column. The low air pressure employed for the check ensures that only valves with good low-pressure reseating characteristics are accepted. Following this stage, the operator stakes-in the plugs, on the arbor press seen at the right in Fig. 9.

ASSEMBLING RELIEF VALVES

The relief valves are of an encapsulated type, designed for close cut-off and good reseating characteristics, and are pre-set to operate at a prop load of 20-21 tons. Assembly of the valves is carried out by one operator, the bi-manual layout being shown in Fig. 10. A 2-station fixture is provided, and assembly begins with the lock-nuts seen at *B*. Before the lock-nuts are loaded into the fixture, the ring seals are snapped into the grooves, with the aid of a tapered ferrule, and smaller ring seals are inserted in recesses in the upper ends.

In the fixture, each lock-nut is located by the hexagonal portion, and a seating disc, the testing of which was described in the preceding article, is placed over the upper ring seal. Next, the cylindrical body, in which the valve assembly is completely enclosed, is screwed on to the plug portion, by means of the special tool shown. This tool engages the flats on the sides of the body, and is provided with a conical-ended, spring loaded pin *C*, which engages and locates the seating disc by the central aperture. The remaining details of the valve, comprising the ball, ball guide, spring guide and spring, are then inserted, and are retained by the adjusting nut, which is screwed into the upper end of the body.

Setting and testing of the valves is performed on the hydraulic rig shown in Fig. 11, where each in turn is held in a bayonet-lock adapter. Hydraulic pressure is applied by means of an air/hydraulic pump, and the valve is set to release at 3,655 lb. per sq. in., ±40 lb. per sq. in., by reference to the pressure gauge. Once set, the valve is checked six times, by applying pressure with a hand pump, and observing, from the gauge, the pressure at which it reseats.

Some further examples of the methods employed in the sections devoted to main fabrication, assembly and testing, will be discussed in a later article to be published in MACHINERY.

Revel Industrial Cleaning Equipment

Products of Revel Engineering Co., Ltd., Hayes Road, Southall, Middlesex, include automatic

Revel type CT30A two-stage industrial cleaning equipment. Intended for use in a conveyor line, it has two 30-gal. tanks

industrial cleaning units for use in conveyor lines, and an example is shown in the accompanying figure. Known as the type CT30A, it incorporates two cleaning tanks each of 30 gal. capacity. Baskets of work, fed to the equipment by way of a roller track, move on to a roller table which is lowered by means of an air cylinder to immerse the work in the first cleaning tank. The table is then raised automatically, and an overhead travelling arm, which is also air-operated, transfers the basket of work to the table of the second cleaning tank, wherein it is immersed. Upon completion of the cleaning operation, the overhead arm moves the work basket to the unloading position.

The unit operates on compressed air at a pressure of 80 lb. per sq. in., and the sequence is controlled by an electric process timer. For heating the cleaning fluid, 4-kW., thermostatically-controlled immersion heaters are provided, and a canopy hood, which can be connected to ducting, extends over the full length of the unit. The dipping space in each tank measures 20 by 17 by 12 in. deep. A larger, 2-stage standard unit, known as the type CT60A, is available, which incorporates cleaning tanks measuring 26 by 20 by 16 in. deep, each holding 60 gal. of cleaning fluid.

Grinding Inner Races for Double-row Taper-roller Bearings

A TYPICAL APPLICATION of the Wotan type S 313/12U hydraulic internal grinding machine (Soag Machine Tools, Ltd., Juxon Street, London, S.E.11) is for operations on inner rings for double-row taper-roller bearings, during which the bore, the end faces, the tracks, and the associated thrust shoulders are finished at only two set-ups. A general view of the type S 313/12U machine, with a bearing ring in position on the faceplate, is shown in Fig. 1. A feature of this machine is that the work-head has a transverse movement of 44 in. and can be swivelled about a vertical axis through 90 deg. In addition, the grinding head can be swivelled through 20 deg., also about a vertical axis.

At any angular setting of the work-head between 0 and 20 deg., the machine will swing 51 in. diameter, and at other settings between 20 and 30 and 30 and 90 deg., it will swing 44 and 40 in. diameter respectively. With a 14-in. diameter grinding wheel, a maximum bore size of 48 in. can be ground. The grinding head slide has a movement of 48 in., which provides for grinding bore depths up to 28 in. Other machines in the type S 300 range have capacities for workpieces up to 48, 44, and 40 in. diameter with the work-heads at any setting between 0 and 20 deg. The transverse adjustment of 44 in. for the work-head is common to all machines in the range, as are the grinding head stroke and maximum depth ground (quoted above).

The various stages in the sequence for grinding the bearing ring seen in Fig. 1 are shown diagrammatically in Fig. 2. At *a* it will be noted that the work-head and grinding spindles are parallel, and the bore of the ring is ground in the conventional manner. A range of ten feeds is available for the grinding head, from 0·0001 to 0·001 in., on diameter, and an increment is applied hydraulically at the end of each pass. The selected feed rate is automatically changed to 0·0001 in. per pass for finishing, and the feed is automatically disengaged when the required size has been reached.

For grinding one track, as at *b*, Fig. 2, the work-head is swivelled to the required angle and is moved transversely and clamped. The grinding spindle is also swivelled and the wheel is dressed to a tapered form. Power traverse for the transverse movement of the work-head is controlled by push-buttons, and accurate setting of the heads is facilitated by the use of gauge rods and dial indicators. Only a small reciprocating stroke is required for the grinding head at this stage, and the minimum movement of ⅛ in. is employed.

Next, the machine is set for grinding one of the thrust shoulders at the centre of the bearing ring, and the disposition of the work-head and grinding spindle for this operation are shown at *c* in Fig. 2. The work-head is swivelled to bring the shoulder face parallel with the centre line of the machine. A tapered grinding wheel is again employed, and the spindle is swivelled to a setting equal to half the included angle. For this stage, no reciprocating motion is required, and it will be appreciated that the design of the race must be such that the angle of the thrust shoulder is sufficiently great to allow the grinding wheel to be introduced without interfering with other faces on the workpiece. Setting is facilitated by the use of gauge rods and dial indicators.

The last stage provides for grinding one end face,

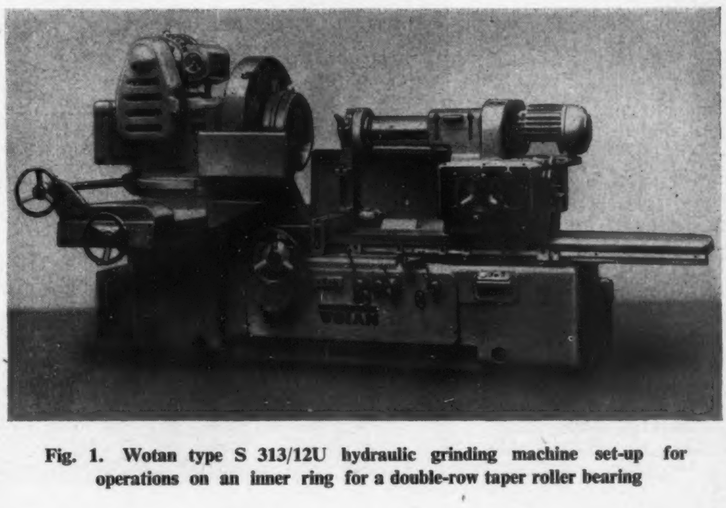

Fig. 1. Wotan type S 313/12U hydraulic grinding machine set-up for operations on an inner ring for a double-row taper roller bearing

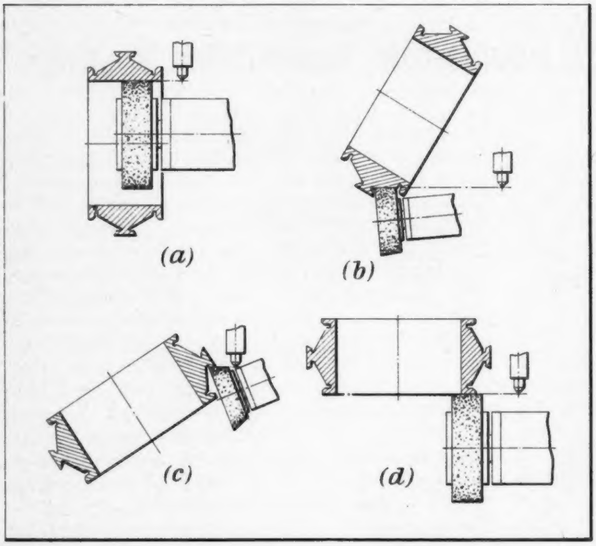

Fig. 2. Four stages in grinding the bearing ring are here shown diagrammatically. At the end of the sequence, the ring is removed and turned end-for-end, to enable the remaining faces and track to be ground

and for this operation the work-head is swivelled through 90 deg. as seen at *d*. The grinding spindle is returned to its normal position and the operation is carried out with the periphery of the same wheel that was used to grind the bore, as at *a*. Feed is applied incrementally, as for internal grinding. For the remaining track and faces, the bearing ring is removed, and turned end-for-end.

Thermatool High-frequency Fin Welding

The patented Thermatool high-frequency resistance welding process developed by the New Rochelle Tool Corporation, 320 Main Street, New Rochelle, N.Y., U.S.A., is now, it is stated, being used by numerous firms in various countries.

Reference has already been made in MACHINERY, 95/377—2/9/59, to the process, for which high-frequency current, up to 450,000 cycles per sec., is employed. The current follows the low inductance path rather than the low resistance path, and the skin effect results in localized heating of very high intensity. It is claimed that the high-frequency resistance technique thus affords the same possibilities and advantages for seam welding, as do spot and impulse welding for joining metals at specific points, and enables high quality welds to be produced at exceptionally high speeds.

The technique is particularly intended for pro-

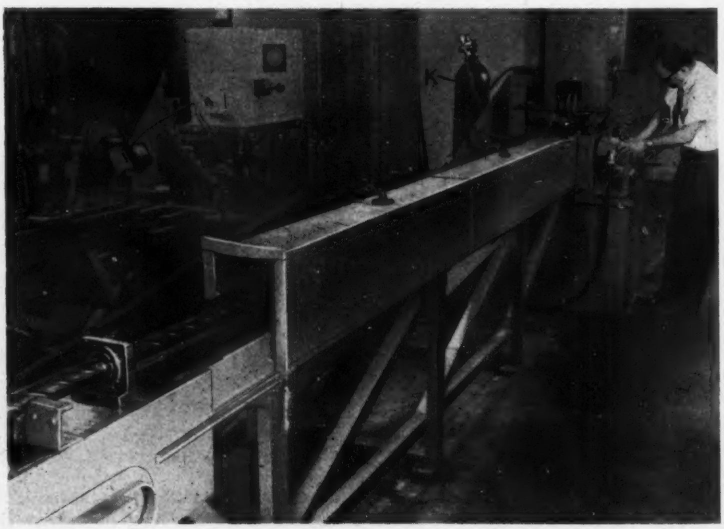

Fig. 1. Thermatool high-frequency resistance welder and draw bench for welding spiral or parallel fins to the surfaces of tubes

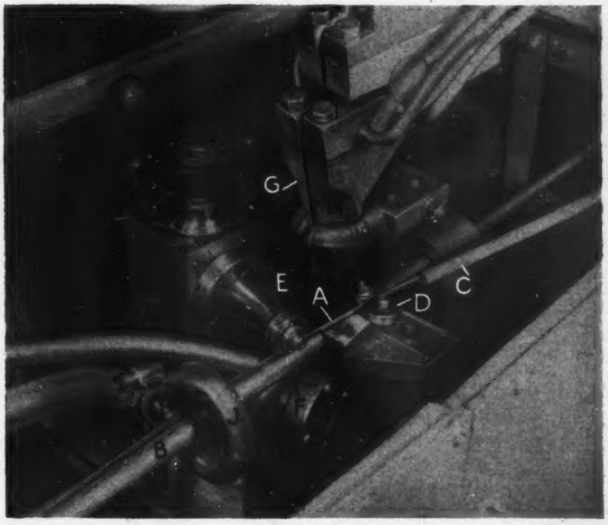

Fig. 2. Close-up view of the Thermatool welding head with the electrodes raised clear of the fin strip *A* and the tube *B*

ducing tubing of ferrous and non-ferrous metals, including 100 per cent conductivity copper, stainless and galvanized steel, hot and cold rolled steel, and the rarer metals such as zirconium and titanium. Also, metals with different characteristics can be welded at high speeds, for example, copper to steel, and high-speed steel to carbon steel. The same welding head can be used to weld, continuously, various metals and alloys ranging in thickness from 0·004 to ⅜ in., at speeds up to 1,000 ft. per min.

In Fig. 1 is shown a specially-designed draw bench, used in conjunction with a Thermatool high-frequency resistance welder, to weld a spiral or a parallel fin on to ferrous or non-ferrous tubing. One particular application, in the nuclear energy field, involves welding a zircalloy spiral fin to zircalloy tubing previously seam welded by the process. A close-up view of the welding unit is given in Fig. 2, which shows a parallel fin *A*, being welded to the tube *B*, the latter being supported on a mandrel. The fin material, fed through the guide tube *C*, passes between rollers at *D*, and beneath the vertically-adjustable grooved roller *E*. Support for the tube is provided by the roller *F*.

There are two welding electrodes, seen at *G* and *H*, raised clear of the work. The electrode *G*, bears on top of the strip, and the electrode *H*, on the tube, alongside it. The tube and fin are brought together in an elongated vee, the root of the vee being located at the squeeze rolls *E* and *F* where welding takes place. For welding zircalloy and certain other metals, it has been found desirable to carry out the operation in a protective atmosphere, and argon has proved most effective for the purpose. The argon is introduced through holes in the ring distributor *J*, which is fed with argon from the bottle seen at *K* in Fig. 1.

The ends of the tube and the fin strip are locked together in the pull head of the draw bench, and when a spiral fin is required, the pull head is rotated by means of the helically grooved bar in the foreground of Fig. 1. A view of the welder with the front panel removed to show the output transformer is given in Fig. 3, where the zircalloy tube is seen at *B*, and the fin feed tube at *C*. In operation, the welding area is totally enclosed.

Fig. 3. View of the welding head with the front cover removed to show the output transformer

Producing Parts for Lang Pneumatic Equipment

Some Examples of Practice and Equipment Employed by Lang Pneumatic, Ltd., Wolverhampton

By A. W. ASTROP, Associate Editor

As would be expected, a number of set-ups at the Wolverhampton works of Lang Pneumatic, Ltd., provide interesting examples of the application of air-operated equipment to permit efficient medium-size batch production. The company's wide range of pneumatic equipment includes cylinders from $\frac{3}{4}$ to 20 in. diameter bore with a variety of stroke lengths and mounting arrangements, and numerous types of valves, fittings, and associated items from which complete circuits can be built. A typical application of the company's equipment to provide for air-operation of fixtures on a horizontal milling machine is shown in Fig. 1. This Somua type Z1B machine [Machine Tool Sales (London), Ltd.] is used for plunge-milling operations on stainless-steel cores for solenoid valves made by the company, and is provided with a fixture at each end of the work-table.

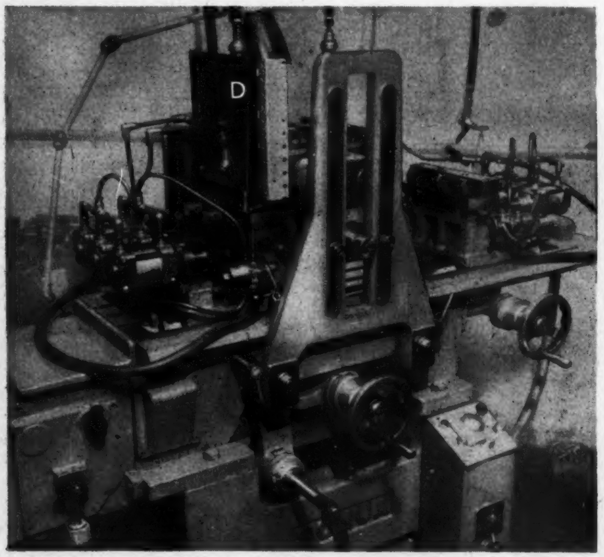

Fig. 1. This Somua horizontal milling machine is installed in the Wolverhampton works of Lang Pneumatic, Ltd., and is fitted with twin air-operated fixtures for plunge-milling operations on cores for solenoid-operated reversing valves

Each fixture is arranged to hold three cores, and unloading and loading is carried out on one fixture while work in the other is being machined. At each stroke of the table, a $\frac{3}{32}$-in. wide slot is plunge-milled in each core in one fixture by a 6-in. diameter side and face cutter (The Brooke Tool Manufacturing Co., Ltd.). There are three of these cutters on the arbor, as may be seen in the close-up view in Fig. 2. where two solenoid cores are indicated at A. There are three slots in each core, and after each working stroke of the table the cores are removed from the fixture and re-loaded into the neighbouring seatings. Projecting tongues in the second and third seatings engage with the previously-milled slots and serve to locate the cores angularly, and with this arrangement the three slots are milled at 120 deg. spacing.

Each core is positioned vertically in the fixture, with the flanged-end uppermost, and is secured during milling by means of a sliding clamp, as at *B*. The tail of each clamp is connected, by way of a toggle arrangement, to a short-stroke double-acting air cylinder, as at *C*. The clamps are seen in the advanced (working) position in Fig. 2, and when air is admitted to the rod end of the cylinder *C*, the piston rod moves to the left and the arms of the toggle close slightly. As a result, the tail of the clamp *B* is pulled down, and the nose is raised from the workpiece. Continued movement of the piston rod pulls the clamp to the left, exposing the component so that it may be lifted out of its seating and transferred

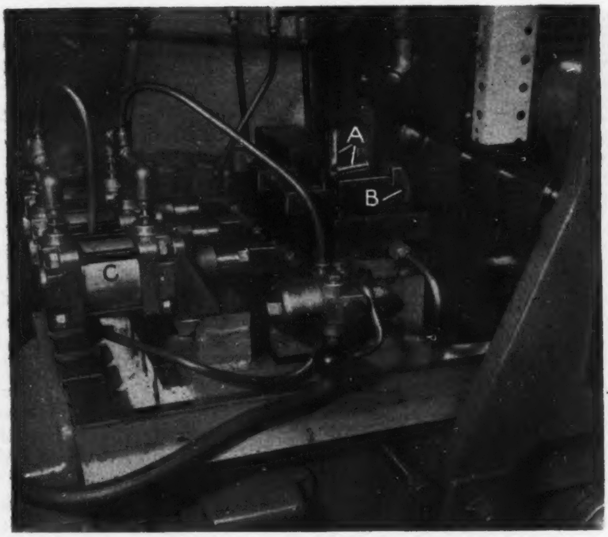

Fig. 2. Close-up view of the machine in Fig. 1, showing the toggle-action clamps and the three milling cutters

to the next position. To clamp a workpiece, the air supply to the cylinder is reversed by means of the lever-operated valve in the foreground. During the first part of the movement the clamp is pushed to the right, to abut a stop and the nose is thus brought over the workpiece. A final movement then serves to open the toggle slightly, with the result that the nose of the clamp is thrust down on to the component.

All three cylinders operate simultaneously under the control of the lever-operated valve at the centre, and, since thrust is applied by way of a toggle mechanism, the work remains securely held even in the event of a complete failure of the air supply. Another feature of this set-up is the provision of automatically - operated cutter guards. One of these guards is indicated at *D* in Fig. 1, and it comprises a plain sheet steel shutter which can be raised and lowered by a double-acting air cylinder. As each fixture is advanced towards the cutters a valve is tripped to raise the adjacent guard. Simultaneously, the other guard is lowered, to cover the opposite edges of the cutters and to protect the operator while he is loading and unloading the other fixture.

AIR-HYDRAULIC CLAMPING FIXTURE

The company's solenoid-operated valves also incorporate small brass components known as slide carriers. This part is an approximate cube and one of the operations provides for milling a slot, of semi-circular cross section at the root, across one face, to a depth of about one-half the thickness of the cube. A finished milled workpiece is shown at *E* in Fig. 3, with a blank adjacent, and these parts are resting on a special fixture which has been designed and made by the company. Two rows, each of 10 blanks, are loaded into channels in the fixture, as shown, and are located endwise by an adjustable plate at the left-hand end.

The rows of blanks are separated by a ground steel block, indicated at *F*, and are thrust against this block by a number of small axially-sliding plungers, one of which is shown at *G*. There is a separate plunger for each workpiece, and the

Fig. 3. Designed and built by the company, this air/hydraulic fixture provides for holding 20 small slide carriers for a slot-milling operation

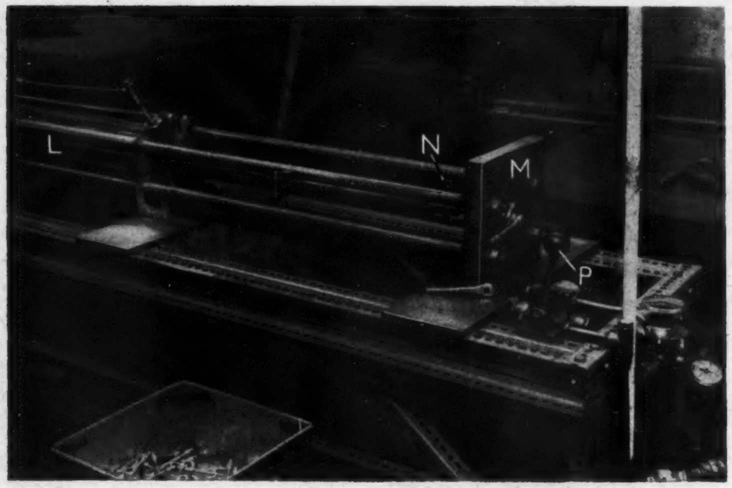

Fig. 4. This simple air/hydraulic broaching machine was designed and built by the company for operations on control levers for manually-operated air valves

plungers are advanced, to clamp the blanks, by oil pressure which is applied to the inner ends. The oil is contained within the compartments *H*, which serve as cylinders. Pressure is applied to the oil in each cylinder by means of axially-sliding pistons *K*, which are advanced and retracted by the air-operated toggle mechanism to which they are connected.

When the pistons are advanced, the small plungers *G* are moved laterally, to thrust the blanks against the block *F*. An adjustable stop mechanism is provided for each half of the toggle, to restrict the movement. When the air supply to the cylinder is reversed, and the pistons *K* are withdrawn, the resultant slight vacuum in the cylinders *H* ensures that the plungers *G* are also retracted. At the left-hand end of each of the cylinders *H* there is an adjusting screw, which imparts axial movement to a short piston. By use of these screws, the effective volumes of the cylinders can be adjusted. In this way, the pressure applied to the plungers *G* can be pre-set independently of the stroke of the toggle mechanism.

AIR-OPERATED BROACHING MACHINE

To facilitate machining square holes in the ends of operating levers for manually-controlled valves, for example, the company has designed and built a simple horizontal broaching machine, a close-up view of part of which is given in Fig. 4. A Lang hydro-pneumatic cylinder is employed to provide an air-hydraulic broach-pulling arrangement, and part of the oil hydraulic cylinder is seen at *L*. The cylinders are of the foot-mounted type and are supported by a bed, built up from Dexion slotted angle. Tie rods from the right-hand end of the cylinder *L* serve to hold a flat steel plate *M*, which is bored to receive a guide bush for the broach. The latter has a tang, which engages with the forked end of the piston rod, and is secured in position by means of the rectangular-section key *N*.

In operation, the tang of the broach is threaded through a workpiece, and the guide bush in the plate *M*, and attached to the piston rod by inserting the key. By operating the valve lever *P*, air is admitted to the cylinder to retract the piston rod and pull the broach through the work. At the completion of the operation, the key *N* is withdrawn, and the broach removed. With this equipment, square holes are broached in workpieces which are brought to the machine either with rough cast square apertures or pre-drilled.

ESSHETE 1250 ALLOY STEEL. Samuel Fox & Co., Ltd., a subsidiary of The United Steel Companies, Ltd., The Mount, Broomhill, Sheffield, 10, have started commercial production of a new austenitic creep-resisting steel known as Esshete 1250 which is intended for service temperatures up to 675 deg. C. It contains chromium 15, nickel 10, and manganese 6 per cent, with smaller percentages of silicon, molybdenum, vanadium, niobium, and boron. This steel, it is stated, combines a high level of rupture strength with adequate ductility, good weldability, structural stability, and oxidation resistance at elevated temperatures for long periods. It also has good manipulation properties and is claimed to be well suited for service in power stations of advanced design. Bars, tubes, pipes, and large forgings have been produced satisfactorily, and trials with sheet are in progress.

The Mechanics of Chip Formation*

By S. N. AGRAWAL,[1] R. D. HARRIS[2] and B. H. AMSTEAD[3]

THERE ARE MANY THEORIES associated with the cutting of metal. Some investigators have likened the process to a successive shearing action. One reported that in addition to shear, other considerations involved are grain compression, the slip of cleavage planes, rotation of slip planes, and "twinning." Another has visualized chip formation as being akin to the flow of viscous material over the tool face, similar in nature to that which occurs in squeezing or upsetting. A recent theory discards the idea of a shear plane and states that deformation during metal-cutting is continuous.

In an effort to secure more information on the process, a technique was developed whereby basic data on metal-cutting may be rapidly recorded, and subsequently analysed. The equipment and set-up employed are shown diagrammatically in Fig. 1.

In order to minimize the difficulties encountered in photographing chip formations at high speeds, a shaper was converted into a "planer." For this purpose, the tool and the work were "reversed," the work being secured in a fixture on the ram and the tool being rigidly held in the vice on the shaper bed. The camera was mounted in a fixed position on a table attached to the bed and was focused on the tool tip.

A $\frac{7}{16}$-in. square Rex AAA high-speed-steel cutting tool, supplied by the Crucible Steel Co. of America, was used for all the tests. The back-rake angle varied from 15 to 30 deg. and the relief angle was 8 deg. A strain gauge, fitted to the tool-holder, indicated tool forces and the resulting vibration. Strain-gauge response was magnified by means of a bridge and an amplifier having a maximum amplification of 15,000. The amplified signal formed the input to a mirror type galvanometer which reflected a beam of light delivered from a light source to a clear mirror. This mirror, in turn, reflected the beam to the film in accordance with, and in proportion to, the strain on the tool. The response rate of the system was tested at camera speeds up to 7,000 cycles per sec.

A high-pressure, point-source, air-cooled mercury-arc lamp, rated at 140,000 candles per sq. cm., was used to supply a beam of light for recording tool force. To enable the magnitude of the tool force traced on the film by the light beam to be calibrated, a known force was applied to the tool and the corresponding deflection of the beam was observed in the reflex telescopic view finder of the camera.

The Fastax high-speed motion-picture camera employed has a lens section designed to magnify the image five times. This magnification is relatively large in comparison with that normally employed to photograph non-luminous subjects. Most of the studies to date have been accomplished

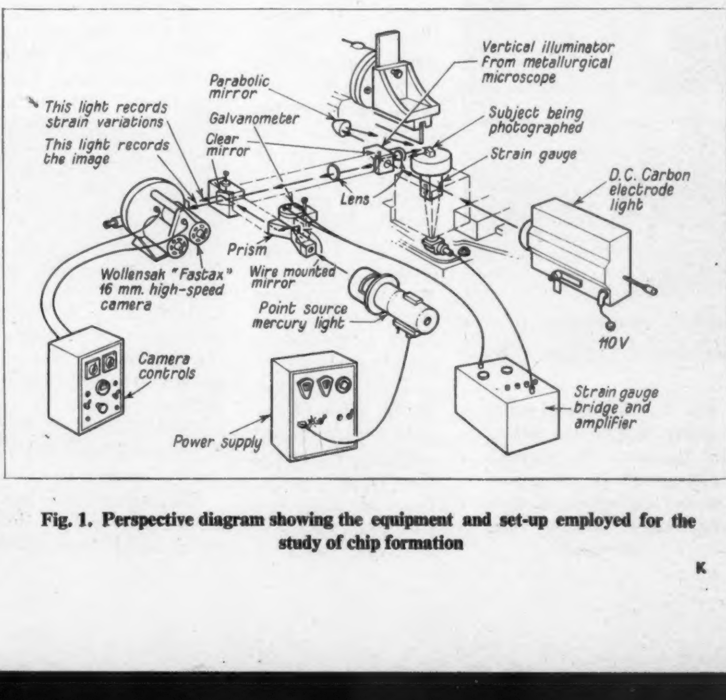

Fig. 1. Perspective diagram showing the equipment and set-up employed for the study of chip formation

* Abstract of a paper read before the American Society of Mechanical Engineers.

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2 Professor at the University of California.

3 Assistant dean of the College of Engineering, University of Texas.

with maximum camera speeds from 3,000 to 7,000 frames per sec. A 110-volt, d.c., carbon-electrode lamp provided light for photographing the image, and a vertical illuminator from a metallographic microscope was incorporated in the objective lens attachment to direct light on to the subject. Additional light was focused on the subject by a parabolic-shaped mirror accurately located to collect rays which "spilled" around the lens section.

A micro-switch attached to the shaper ram provided for starting the camera at the correct time. Also, a neon timing light, flashing 120 times per sec., exposed the edge of the film. The camera speed could thus be determined from the number of frames between exposed areas.

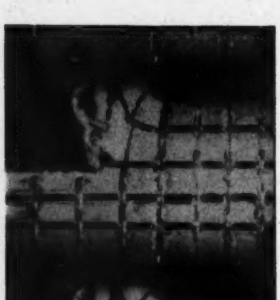


Fig. 2. High-speed photographs showing the cutting of Beeswax. The resulting deformation in the grid of scribed lines helps to illustrate the stress pattern that developed

With the arrangement described, high-speed photographs were taken of polished and etched steel being cut at realistic speeds, and at the same time a record of tool forces was obtained. As mentioned, a magnification of 5 × was used in photographing the subject, and when the developed film was projected on a screen, a magnification of approximately 200 × was possible. At this magnification some grain structure was visible, and deformation details could be viewed.

During the study, some of the data were obtained without recording the tool forces. One of the first materials cut was beeswax, with a specific gravity of 0·960 and a melting temperature of 154 deg. F. Many of the phenomena observed in subsequent tests on mild steel, brass, and aluminium had certain parallels to those associated with the cutting of this wax. A 3/8-in. wide specimen, with grid lines scribed 0·050 in. apart, was employed. The cutting speed was approximately 50 ft. per min., and the depth of cut, 0·10 in., and the tool employed had an 8-deg. relief angle and a 20-deg. back-rake angle.

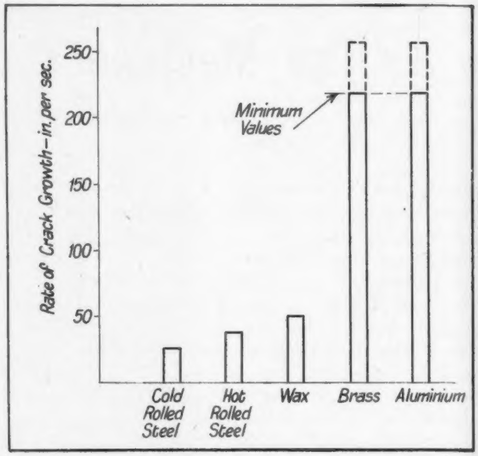


Fig. 3. Relative rates of growth of cracks across chips made brittle by strain hardening due to cutting action

A film strip taken at 7,200 frames per sec., as shown in Fig. 2, illustrates the stress pattern that developed during the machining of the beeswax specimen. Deformation began well ahead of the tool point and was apparent not only in the body of the chip but below the machined surface. The wax deformed into the chip in parabolic fashion, the horizontally scribed lines being carried off with the chip. The vertical lines were compressed in the chip but remained approximately parallel. Near the end of the cut, cracks began to appear in the chip next to the tool face. These cracks were approximately 1/16 in. apart and became wider and deeper as the cutting speed of the shaper reached the maximum. The cracks extended in a direction roughly at right angles to the tool face and were sufficiently deep to extend two-thirds across the width of the chip. Appearance of these cracks was unexpected inasmuch as the wax was thought to be ductile enough to take the strain without fracture.

One investigator has observed that two types of cracks are formed during metal-cutting, both of which result from maximum normal stress, namely

spontaneous cracks that form rapidly in a perfectly brittle material, and relatively slow-growing cracks associated with plastic deformation.

Since the cracks were more prominent in the wax at the higher cutting speeds, it might be reasoned that the strain rate was more severe because of the greater speed. It is generally accepted that most materials are more brittle at high strain rates.

The relative rate at which brittle cracks were propagated across chips of various materials is shown in Fig. 3. Rate of crack growth was determined by counting the number of frames between the beginning and the end of the formation period, the speed of the film being known. There was very little variation in the observed data due to tool modifications or moderate changes in cutting speeds.

This technique may be refined to obtain very accurate values of crack growth rates in various materials. Cracks always appear to grow from the face of the tool towards the free side of the chip. Since the material next to the tool face is most severely strain-hardened, growth would be expected to begin there. In most cases, the crack did not extend completely across the chip, as less strain hardening occurs in the outer portion.

In all the materials studied, cracks probably began, in part, from smaller cracks or non-homogeneous areas in the metal. This theory partially explains why cold-rolled steel showed more frequent, but less severe, cracks than hot-rolled steel. Cold-rolled steel is strain-hardened in the rolling process, grain structure is more refined, and the inclusions and small non-homogeneous areas are more widely distributed.

A photograph from a film strip taken at 6,500 frames per sec. of cold-rolled 1018 steel being cut

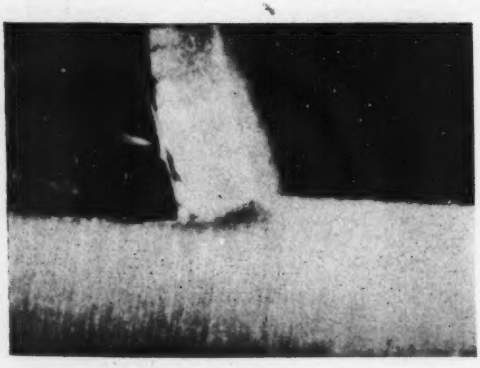


Fig. 4. Photograph taken at 6,500 frames per sec. showing cold rolled steel being cut at 75 ft. per min. Cracks have formed in the chip

Fig. 5. Hot-rolled steel is here being machined at 75 ft. per min. Shear angles varied from approximately 20 to 30 deg.

at 75 ft. per min. and a 0·020-in. cut is shown in Fig. 4. The back-rake angle of the tool was 20 deg. and the relief angle 8 deg. The photograph shows the beginning of a built-up edge and crack formation extending from the tool face toward the centre of the chip. The angle between the horizontal and a line drawn between the tool point and the point where the chip and free surface of the workpiece intersect, which is known as the shear angle, is 22 deg. There is no straight line of demarcation between the two points, however, and very high magnification revealed no deformation by slip.

Two photographs, both taken while machining A755T hot-rolled steel at 75 ft. per min., with a 0·020-in. cut, are shown in Fig. 5 and 6. The tool had a back-rake angle of 20 deg. and a relief angle of 8 deg. Both exposures were made at 6,000 frames per sec.

Although the shear angle of the cutting action in both Fig. 5 and 6 is 22 deg., the angle varied from approximately 20 to 30 deg. During the cut a built-up edge (Fig. 6) would begin to form slowly and suddenly grow very large, so that at times it was as much as one-third of the chip thickness. The build-up never remained stationary but instead travelled along the front of the tool. This motion occurred, however, at a much slower rate than the speed of the chip in passing the built-up edge. As the size of the built-up edge increased, so did the rate at which it passed off until both the build-up and chip had the same velocity. In the case of hot-rolled steel, large cracks began to occur in the face of the chip when the build-up passed off. Several cracks would appear in uniform succession at about $\frac{1}{16}$ in. apart, and grow larger at a rate of approximately 40 in. per sec. As soon as the

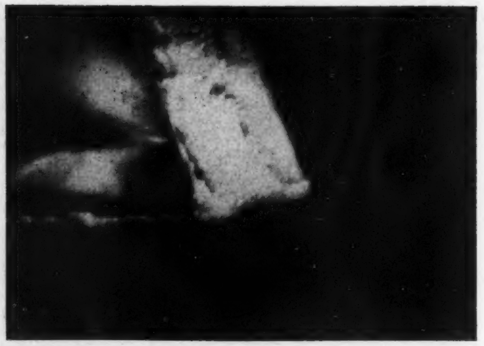


Fig. 6. Another photograph of the operation shown in Fig. 5. A built-up edge is seen being formed in front of the tool

build-up developed, however, the crack formation ceased. There seemed to be no set pattern as to how long build-up lasted or how often it occurred.

The formation of a built-up edge appeared to be caused by the sticking or welding of some of the viscous particles to the tool. This build-up edge, in turn, became the cutting edge. As more of the viscous material stuck to previously adhering particles, instability resulted. When the frictional resistance between successive layers of viscous particles became greater than the frictional resistance between the built-up edge and the tool, the built-up edge would slough off. Since the built-up edge becomes the primary cutting edge during the periods when it is in front of the tool, the sharpness of the basic tool is quite possibly needed only occasionally during a cut in order to set up a well balanced plastic deformation and the proper compressive conditions.

The result of build-up was to increase the effect of shear angle, since the build-up appeared as a rough tool point. A line drawn from the tool point to the point where the chip turned up did not appear to change because of build-up or crack formation alone. When cutting both hot- and cold-rolled steel, the shear angle was found to vary as much as 10 deg. in a few thousandths of an inch of cut without apparent reason.

There was no visible indication that chips left the workpiece as a result of successive shearing action. Instead, the workpiece showed deformation ahead of the tool both in the area where chip removal took place and in the material below the machined surface. The effect of compression and deformation could be observed from the films. The photograph reproduced in Fig. 7, for example, was obtained with a camera speed of 5,000 frames per sec. It shows A755T hot-rolled steel being machined at 92 ft. per min. with a depth of cut of 0·020 in. The tool had a back-rake angle of 16 deg. and a clearance angle of 8 deg.

Unfortunately, with the technique described, it has been found difficult to photograph the grain structure clearly during the entire cut, owing to the undulating nature of the lighting, vibration, and focal length. Added refinements are expected to assist in improving photography, to permit more vivid recording of grain deformation and allow greater magnification in reproduction.

Although they are not shown here, photomicrographs of the workpiece after machining revealed distortion to a depth of several grain "diameters". The grains were deformed ahead of the tool, and in the direction of the cut.

In machining, there is also some lateral deformation—bulging out—of both the chip and the workpiece because of the intense compression ahead of the tool. The process resembles upsetting. Careful viewing of strips of the high-speed film reveals the material in front of the tool in what appears to be viscous form while flowing up the tool point. One can observe this viscous type flow along the face of the tool as well as in the material making up the chip.

It was reasoned that if a chip were predominantly formed by successive shearing action, the tool forces should vary at a frequency analogous to the rate at which the shearing action took place. A number of tests was therefore made during which the tool forces were recorded on the film together with the image of the chip being formed. Although the tool force varied during the cut, there was no correlation between tool

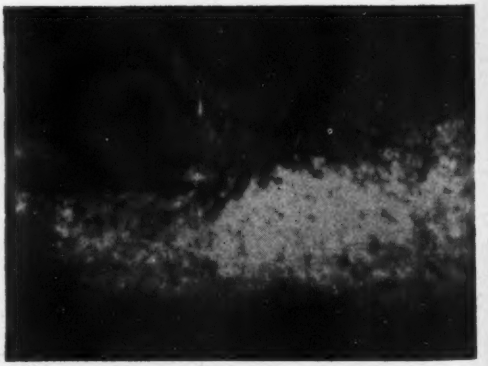


Fig. 7. The deformation seen here in front of and below the tool point occurred during the machining of hot-rolled steel at 92 ft. per min.

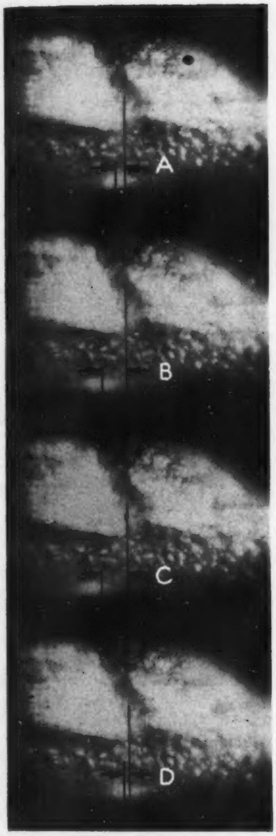


Fig. 8. Variation in tool force is indicated by the positions of the light beam on this film strip, which shows the machining of cold-rolled steel at 92 ft. per min. Lengths *A*, *B*, *C*, and *D* relate to momentary values of tool force

force and shearing action, so far as could be determined.

A portion of a film strip, reproduced in Fig. 8, which was taken at 3,000 frames per sec., shows a piece of cold-rolled 1018 steel being machined at 92 ft. per min., with a depth of cut of 0·010 in. The tool had a 16-deg. back-rake angle and an 8-deg. relief angle. These photographs clearly show the cutting tool, workpiece, chip, and beam of light which, by its distance (*A*, *B*, *C*, or *D*) from a fixed datum, indicates the value of the tool force. Although, as may be seen, the tool force varies considerably (from approximately 400 to 200 lb.), there is no indication that a shearing action has taken place. As this method is refined, considerable information on cutting-tool vibration characteristics should be obtainable. It has not yet been possible to utilize the data relating to tool-force variations accurately to calculate which portions of the forces are transient and which are caused by natural vibrations. Punched tape and computer techniques are to be employed to achieve a better understanding of the data obtained.

In an effort to check the response of the light beam indicating tool force, a workpiece was prepared with vertical $\frac{1}{16}$-in. slots cut at various intervals. When the chip was separated from the workpiece, the tool force, in every case, fell to a zero value instantly. At the end of a cut, the base material beneath the tool broke off at a downward angle and not in the direction of the shear plane. Although it was observed that the material ahead of the tool point deforms in the direction of the cut, only during the final fracture of the chip away from the workpiece is it possible to observe any sharp demarcation of deformation or stress, and only then does tool force fall to zero. This technique of recording dual data in synchronism offers unusual opportunity to investigate the details of tool-force variation.

Initial results of the tests indicate that the cutting action is not predominantly one of shear, but one of continuous deformation. The action is a combination of compression, bending, and viscous flow, and slip and "twining" are involved to some extent. The material in front of the tool is compressed and ultimately fails as it escapes over the tool face in the form of a chip under high frictional resistance. Owing to the intermolecular cohesion in the part being machined, the grains are deformed in the direction in which the tool is moving when the tool force is applied. A free-body diagram of the material ahead of the tool may be likened in some respects to that of a cantilever, since the final separation of the chip is in the direction in which a fracture in this type of structure should occur. Further, the stress at failure and the deflection of a cantilever are proportional to its tensile strength. This relationship is in agreement with the established fact that machinability varies inversely with tensile strength.

CONCLUSIONS

From these tests a satisfactory analysis of metal-cutting, at least for materials such as mild steel, would be generally as follows:

First, the grain boundaries of the workpiece are apparently compressed in front of the tool. As a result, a slight lateral elongation of the material occurs. Then, under high compression, the grains in front of the tool are bent forward and distorted in the direction of the cut. Under these stresses (both in the direction of, and approximately at right angles to, the cut) the material fails and escapes over the tool in the form of a chip. Grains in the finished surface of the workpiece are distorted and it follows, therefore, that plastic deformation takes place in both the chip and workpiece. Because of the higher pressures and temperatures developed, the material in contact with the cutting edge is more viscous in nature than

the material in the outer part of the chip. Also, the high degree of strain hardening that takes place along the tool face promotes the growth of cracks from this face toward the chip centre.

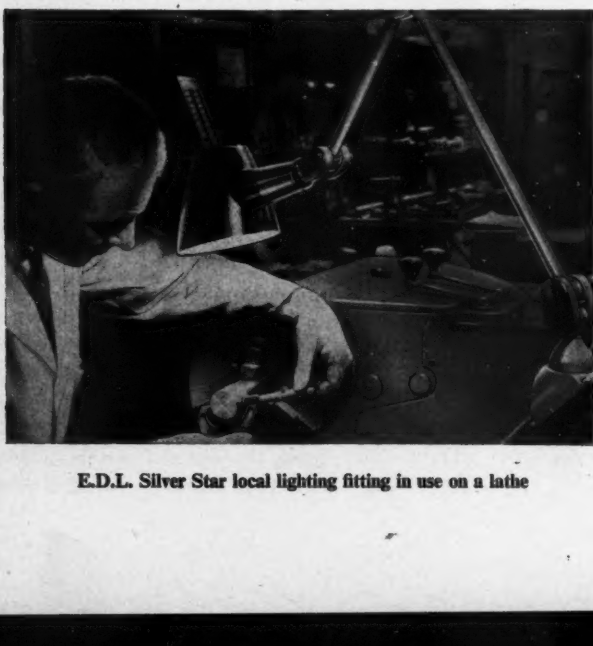
The tool face and the chip flow shown in the high-speed photographs bear a resemblance to the bow of a ship ploughing through water, and an analogy to hydrodynamic flow appears plausible.

E.D.L. Silver Star Industrial Lighting Fittings

E.D.L. Industries, Ltd., Brereton, Rugeley, Staffs., have extended their range of industrial local lighting fittings by the introduction of a new type known as the Silver Star, which has been accepted by the Council of Industrial Design. In the figure, a Silver Star fitting is seen in use on a lathe. Two forms are available, namely the SSU/1 with universal base, and the SST/1 with a simpler alternative base.

Features of the fittings include a special form of hinge joint which allows 360 deg. movement, and, it is stated, remains permanently in adjustment. The flex is totally enclosed and will not kink or twist, and the reflector can be turned to direct the light as required. A switch is provided in the base, which has four conduit entries to permit horizontal or vertical mounting.

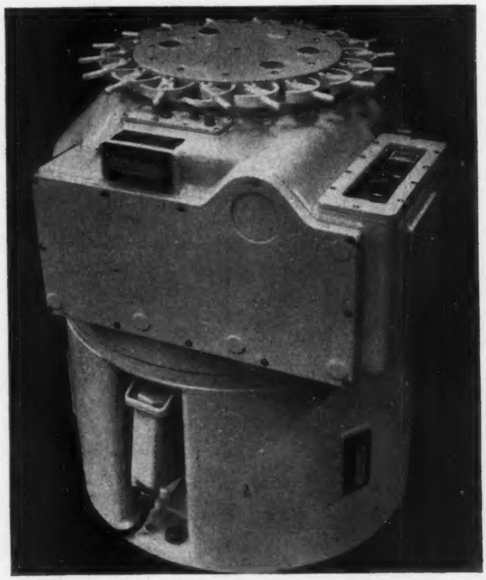
The fitting is suitable for use with a 60-watt lamp on mains voltage, or in conjunction with a step-down transformer for low voltage lighting. When extended it is 36 in. long and the weight is 5¼ lb.



E.D.L. Silver Star local lighting fitting in use on a lathe

Pratt & Whitney Precision Rotary Table

Built by the Pratt & Whitney Co., Inc., West Hartford, Conn., U.S.A. (Buck & Hickman, Ltd., Otterspool Way, By-Pass, Watford, Herts.), the precision rotary table here shown was developed primarily as part of an azimuth indicator in a missile aiming system. The accuracy of setting to any point within a full circle is claimed to be within ±1·5 sec. of arc.



This Pratt & Whitney rotary table, which was developed for use in missile aiming systems, permits angular settings to be made with very high accuracy

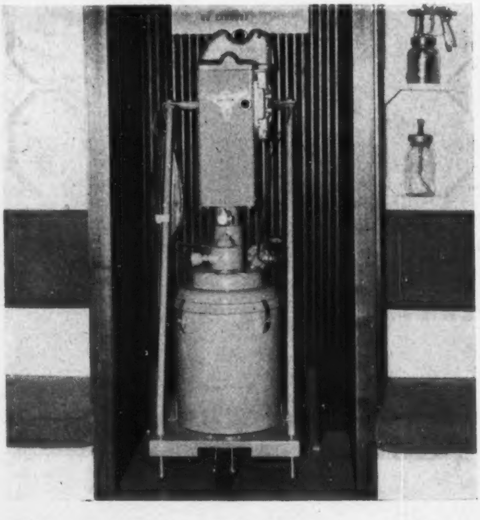
Setting is made with reference to duplicated sets of counter-type indicators, which are marked in deg., min., and sec. of arc and can be observed through windows. Provision is made for setting to a datum position by either turning the table while the counters are held at a pre-set reading or maintaining the table stationary while the counters are adjusted to zero. To ensure accuracy, warning lamps are illuminated if the correct procedures for the removal of backlash are not followed.

New Aerostyle Spraying Equipment

A new automatic painting and drying unit, built by Aerostyle, Ltd., Sunbeam Road, London, N.W.10, was among the equipment displayed at the recent Industrial Finishes Exhibition. This unit has been sold to Archibald Kenrick & Sons, Ltd., West Bromwich, and was demonstrated in use for finishing wheels for Shepherd castors made by this company.

Work is transported through the unit by a Chainveyor overhead chain conveyor, driven by a variable-speed motor, and the conveyor can support a load of 60 lb. per ft. run. A total of 170 work carriers are provided, each of which will accommodate six components. Loading is performed by two operators, who transfer the parts from trays delivered by gravity roller conveyor. During the first stage of movement through the unit, paint is applied to the work by means of French-made S.A.M.E.S. Statron electrostatic equipment, for which Aerostyle, Ltd., are the agents in this country. The spray gun associated with this equipment is set at a distance of 8 to 10 in. from the work-path, and is operated continuously. For drying the paint, the work passes through four heating galleries in a gas-fired infra-red oven, and then through an air after-cooler. Unloading is performed by a single operator, and the parts are deposited in a chute that directs them to a tray carried on a second roller conveyor. As an indication of the efficiency of operation, it is stated that an output of 4,000 wheels per hour is obtained, for the consumption of 2·6 pints of paint.

New hand-operated, electrostatic flock-spraying equipment was shown, and the display also included the Lincoln No. 1722 No-Air Dyna-Spray airless paint spraying unit seen in the illustration. Mounted on a wheeled trolley, which occupies a floor space of approximately 2 ft. square, the unit is self-contained, and incorporates a 5-gal. reservoir from which paint is drawn by a compressor and delivered at high pressure to the spray gun. A 100-mesh stainless steel filter is provided in the system. Various tungsten carbide spraying nozzles are supplied, and the gun is connected to the unit by a 25-ft. long Teflon plastics hose. A number of advantages are claimed for the airless spraying process, among which may be mentioned the very small amount of overspray obtained and the elimination of the tendency for paint particles to bounce from the work, so that extraction equipment is less frequently required. It is stated that the unit provides well-defined spray patterns, thereby reducing the need for masking, and the output of the compressor is such that the paint does not have to be heated.

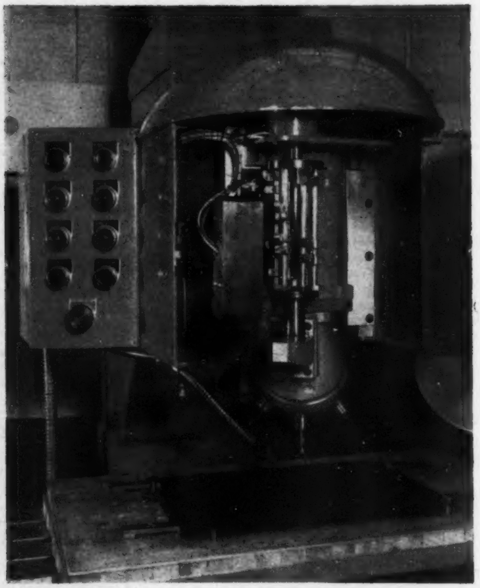


Lincoln No. 1722 No-Air Dyna-Spray self-contained airless paint spraying equipment

Tape-controlled Drilling Machine at the Leicester Works of A.E.I., Ltd.

At the electronics and marine radar works of A.E.I., Ltd., Leicester, a Vero co-ordinate setting, turret type, drilling machine, with Autoset N 271 tape control equipment supplied by Airmec, Ltd., High Wycombe, Bucks., is employed in the production of chassis for electronic units, which are often required in small batch quantities. As an indication of the output which is obtained, it is stated that operations involving the drilling of a total of 97 holes are completed in a cycle time of 12 min., and the need for jigs has been avoided. Programming is said to require no special skill, and is performed by a girl, who works direct from the detail drawings.

To facilitate positioning the work, a simple fixture is used, with a wooden baseplate, which is mounted on the machine table. With the aid of the control equipment, holes to accommodate three location pegs are drilled in this baseplate, in positions to suit the component. After loading, the work is secured to the base by means of screw-



For positioning work on a Vero co-ordinate setting drilling machine at the works of A.E.I., Ltd., Leicester, a wooden baseplate is employed, as here shown, with location pegs driven into drilled holes that are positioned by use of the control system

operated clamps, as can be seen in the accompanying close-up view of the working area.

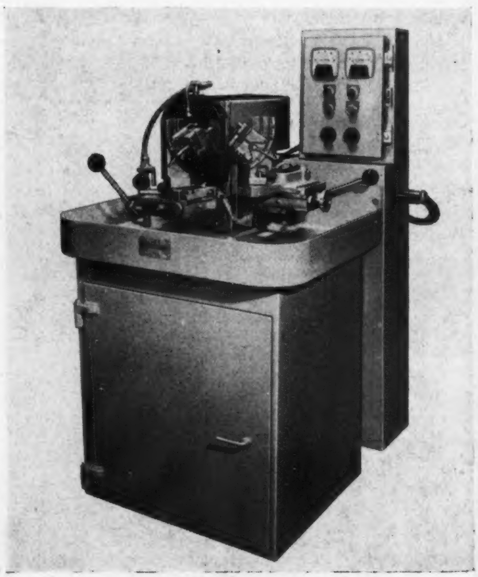
In this illustration, the cover at the front of the machine head is swung aside to show the arrangement for controlling vertical movement of the drilling head. In connection with the feed motion, there are two adjustable stops mounted on each of a number of bars in a turret-type holder, which is indexed simultaneously with the spindle carrier. One or the other of the two series of stops which are thus provided is brought into position for operating the micro-switch associated with the feed mechanism by turning the bars manually. With this arrangement, holes of a maximum of 12 different diameters can be drilled, without the need for re-setting, by the use of stepped drills.

Autoset co-ordinate setting control equipment may be used in conjunction with machines of other types, and was described in MACHINERY, 93/616—10/9/58 and 95/1179—2/12/59, and the latter article was concerned primarily with the Vero machine. It may be recalled that movement of the table is determined by measuring the angle through which the traversing screws are turned, and it is stated that settings are normally made and repeated to within 0·7 and 0·3 deg. of arc, the former corresponding to a movement of 0·0002 in. when a screw with 10 threads per in. is employed. Sole distributors for the Vero co-ordinate setting drilling machine are Catmur Machine Tool Corporation, Ltd., 103 Lancaster Road, London, W.11.

Ampak Electrolytic Twist Drill Sharpening Machine

In the illustration is shown the Ampak electrolytic machine for sharpening high speed steel twist drills, which has been introduced by Connecticut Special Machine, Inc., Winsted, Conn., U.S.A. With this machine, it is claimed, the time for sharpening a drill is greatly reduced, as compared with that required for grinding, and there is no risk of overheating the tool.

Point angles from 90 to 180 deg., and relief angles from 0 to 20 deg., can be produced on drills with helix angles from 30 deg. positive to 30 deg. negative, and the pre-determined point shape, it is stated, is controlled with high accuracy throughout large-quantity batches. A simple arrangement is used for holding the drill during the sharpening



Ampak electrolytic twist drill sharpening machine

operation, and setting up can be carried out quickly.

Drive for the electrode wheel is taken from a 1-h.p. motor, and for electrolytic erosion, a power supply up to 300 amp. d.c., at a voltage which may be varied from 1 to 8, is provided by a self-contained unit, which incorporates a silicon diode rectifier. Control to within ¼ volt of the pre-set value is obtained by means of two valves, each of which has a guaranteed life of 10,000 hours. This power unit is also marketed separately, for use in other applications. A visual warning is provided in the event of overloading, and the electrolyte is circulated by a self-contained system. The machine occupies a floor space of 3 ft. 2 in. by 3 ft. 1 in.

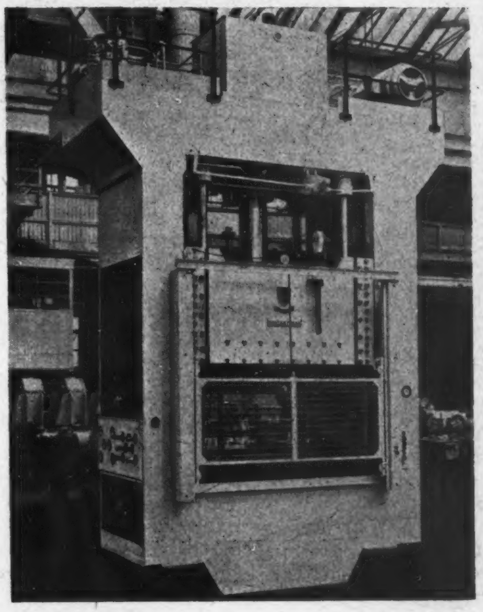
Ellisviewer Bench Illuminator Magnifier

In the figure is shown the Ellisviewer bench illuminator magnifier which has been introduced by the Ellis Optical Co., Mayday Road, Thornton Heath, Surrey. The hood unit, in which are housed two electric light bulbs, carries a glass lens of 5 in. diameter, with a magnification of 2½ ×. This unit can be swivelled in its holder, and the latter is adjustable vertically on the column, so that the light can be directed at the best viewing angle, and the lens focussed to suit the work to be examined. A press-button switch for the light bulbs is incorporated in the base.

Ellisviewer bench illuminator magnifier

Foster, Yates & Thom Lancastrian 300-ton Triple-action Hydraulic Drawing Press

The accompanying illustration shows a triple-action Lancastrian hydraulic drawing press of 300 tons capacity which has been built for the Speedwell Gear Case Co., Ltd., Tame Road, Witton, Birmingham, by Foster, Yates & Thom, Ltd., Blackburn, Lancs. It has a bed area of 7 ft. by 4 ft. 6 in., and the shut height is 3 ft. 8 in.



Foster, Yates & Thom Lancastrian 300-ton triple-action hydraulic drawing press

Features of this press include finger-tip control of the tonnage of the main ram and die cushion, and provision for adjusting, individually, the blank-holding pressure exerted by the four rams. In addition, the die cushion pressure can be automatically adjusted during the working stroke. The press performs an automatic cycle when the start button is pressed, and the ram can be arranged to stop and reverse when either a pre-set pressure or a predetermined position is reached. For single-acting tools, the sub-ram is used as a cushion.

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The East German Institute of Machine Tool Engineering

By R. E. GREEN, Associate Editor

THERE ARE APPROXIMATELY 50 machine tool building factories in East Germany, and most of them are members of the Werkzeugmaschinenwerke association, which is usually abbreviated to W.M.W. These initials were adopted by the Modul gear-machine factory of Karl-Marx-Stadt, in 1949, and a badge on which they appear is now employed by members of the association as a mark of quality on their machine tools. Examples of the products of the East German industry, displayed at the Leipzig Spring Fair, have been described recently in MACHINERY,* and figures published in the periodical *German Export*, No. 7, 1961, indicated that some 42,500 metal-working machine tools, including both cutting and non-cutting types, will be built this year.†

Under the current 7-year plan for the expansion of the country's economy, which covers the period up to 1965, the output of machine tools is to be expanded to an annual rate of 110,000, and the greatest increase will be in non-cutting types. The plan provides for the supply of 22,000 automatic machines, 300 transfer machines, 950 linked lines of machines, and 1,450 other machine lines, to be installed in various mechanical engineering factories between now and 1965, also for substantial numbers of machine tools for export.

Table 1, taken from the Statistical Pocket Book published by the Governmental Central Administration for Statistics, shows the numbers of selected machine tools built in East Germany during the years up to and including 1959, and although it does not include some of the more important types of machine it does afford some indication of the scale of operation. It is stated that the development of the industry in that country during the last five years has been largely affected by arrangements made by the Council for Mutual Economic Aid, which were intended to avoid overlapping or duplication of production, and to ensure that the best use was made of any new capacity which became available.

Investigations conducted by the Council showed that several of the communist countries were making similar machines, and engaging in research and development work along similar lines. Arrangements were therefore made to reduce such

* See MACHINERY, 98/939—26/4/61, 98/1006—3/5/61, 98/1074—10/5/61 and 98/1119—17/5/61.

† The figure of 65,000 quoted in the first of the earlier articles presumably included wood-working and other types of machines.

duplication, and it was laid down that the simpler machines should be built by the less industrially-developed countries, leaving more complicated and special machines to be built by those countries where industries have been brought to a higher technological level. These arrangements enabled the East German industry to reduce the number of different machines built by about 30 per cent, leaving some 338 types of cutting and 270 types of non-cutting machine tools in production, and these figures have since been further reduced by the adoption of the unit construction system, to which reference will be made later.

Another important factor which has encouraged East Germany to build the more complicated automatic machine tools, involving higher proportions of labour costs, is the shortage of raw materials. Much material has to be imported from West Germany and the communist countries, and to pay for such imports, large numbers of machine tools are exported, to both communist and non-communist countries. The numbers of machine tools, of selected types, exported during the years 1955, 1958 and 1959, are shown in Table 2, also taken from the Statistical Pocket Book mentioned earlier. Comparison of the two tables shows that considerable proportions of the total outputs of some machines were exported in 1959.

TABLE 2. EAST GERMAN EXPORTS OF SELECTED TYPES OF MACHINE TOOLS DURING THE PERIOD FROM 1955 TO 1959

Type of machine	Year		
	1955	1958	1959
Lathes (all types)	840	1,092	1,221
Turret lathes	58	134	154
Automatic lathes	103	151	161
Milling	906	972	1,149
Jig boring	26	66	63
External cylindrical grinding	97	124	108
Surface grinding	73	116	157
Radial drilling (up to 1·5-in. capacity)	31	64	89
Eccentric-, crank- and toggle-type presses (of more than 125 tons capacity)	308	582	596
Hydraulic presses	268	607	793
Guillotine shears	770	1,475	1,052

THE INSTITUTE OF MACHINE TOOL ENGINEERING

Co-ordination of the efforts of the machine tool building factories, to avoid the duplication mentioned above, also research and development work on machine tools, is performed by the Institute of Machine Tool Engineering. Started some six years ago, this Institute was initially housed in scattered premises in the town of Karl-Marx-Stadt (formerly Chemnitz), in the district of the same name, bordering Czechoslovakia. In this district, it may be noted, there are more than 700 heavy engineering and other metal-working factories, producing machine tools including large lathes, milling and plano-milling machines, gear-cutting machines, and heavy boring machines, textile machinery, motor cars, lorries and motor cycles. Mining is also carried on in the area, which is the most densely populated in East Germany, with some 2·3 million of the total of 16 million inhabitants.

TABLE 1. EAST GERMAN PRODUCTION OF SELECTED TYPES OF MACHINE TOOLS DURING THE PERIOD FROM 1950 TO 1959

Type of Machine	Year			
	1950	1955	1958	1959
Lathes (all types)	4,422	4,851	4,513	5,501
Turret lathes	127	533	598	552
Automatic lathes	152	270	433	756
Milling	1,933	1,687	2,970	2,956
Jig boring	7	129	179	173
External cylindrical grinding	125	322	431	322
Internal cylindrical grinding	129	149	302	351
Single-spindle drilling (up to 0·75-in. capacity)	2,903	4,636	5,089	5,344
Radial drilling (up to 1·5-in. capacity)	89	100	142	159
Eccentric, crank- and toggle-type presses	556	984	2,028	2,023
Hydraulic presses	353	649	1,463	1,697
Guillotine shears	2,797	5,776	6,544	6,980

The various departments of the Institute have recently been concentrated in new, specially-designed buildings, the office block of which is seen in the heading illustration. Situated at Annaberger Strasse, 231, about two miles from the town centre, these buildings were erected at a cost of 7·3 million marks, equal to about £660,000 at the current exchange rate. In addition to the offices shown, the Institute buildings include a well-equipped canteen with kitchen and facilities for entertainments, and a large test hall, with workshops and offices, where machine tool design and operating problems will be investigated.

A view inside this test hall, taken when it was under construction, is given in Fig. 1, and it is about 246 ft. long by 30 ft. wide, and has a clear height of 26 ft. beneath the crane tracks. There are two cranes, of 5 and 12·5 tons capacity, and each has its own current-carrying bus-bars at the

Fig. 1. In this view in the new machine-testing hall of the East German Institute for Machine Tool Engineering, taken during construction, the vibration-insulated concrete rafts on which machines under test will be installed, may be seen at the left

right-hand end. These bars are supplied with current through sets of contacts arranged at intervals of about 6 ft. along the side of the building beside the right-hand track, so that there is no need for continuous bus bars. Windows occupy almost the whole of the left-hand wall, and the roof is carried on single-span, reinforced-concrete girders.

At the right-hand side there is a two-storey structure which adds about 20 ft. to the width of the building. A corridor, with windows in the wall of the test hall extends along this side, at the first-floor level, and affords access to the row of offices used by the test engineers, also a view over the test floor. Beneath the offices there are workshops and rooms which house equipment for the supply of compressed air, electric power and heat, also lathes, milling machines, and other machine tools for making special auxiliary attachments and components when required. The electrical equipment includes two Ward-Leonard sets for the supply of d.c. power to certain types of machines, and a 3-speed frequency converting installation.

Machines to be tested are installed on reinforced concrete rafts, set in concrete-lined pits in the test house floor, which may be observed in process of construction at the left in Fig. 1. Two sizes of raft are provided, measuring 13 by 11 and 19·6 by 11 ft. respectively, and each is about 5 ft. thick. The rafts are supported on 4-in. thick layers of cork, and pre-loaded compression springs are inserted between the sides of the pits and the rafts. The dimensions of the rafts have been chosen to enable different kinds of vibrations to be damped, and the springs, which are made up in

Fig. 2. Equipment in the standards room at the new Institute building includes this Leitz surface finish measuring instrument, which is equipped with a camera so that permanent records can be obtained

sets, are calibrated to assist in the damping action.

At present, the Institute employs some 340 people, and planned increases will bring the number up to about 380 by the end of this year. It is envisaged that 400 people will eventually be employed. Most of the extra staff will be recruited from technical schools and universities, at the age of 23 to 24, at a salary of £620 to £816 per annum, according to qualifications. After about five years, the salaries will normally rise to between £1,090 and £1,310, depending on ability. The cost of a single-course meal in the canteen, it may be noted, is about 2s. 8d., of which the Institute pays half, and members of the staff who live at some distance have cheap fare facilities on public transport.

Departments housed in the large building in the heading illustration include a drawing office which occupies almost the whole of the top floor, and has windows on each side, and artificial lighting by fluorescent tubes. On the fifth floor there is a large lecture room with equipment for the projection of still and moving films, and offices. Other offices are incorporated on the third floor, as is an extensive reading room with current issues of most of the world's technical journals concerned with machine tools and production engineering. A large translation department is also located on the third floor, with a filing system for records of articles which have been translated.

To date, some 60,000 articles have been translated into German, and for reference purposes there is a card index with a classification number, the date and name of the journal, and a short summary of the contents of each article. In addition, there is an index of subjects and authors. The translations are filed in the form of typescripts, together with photo-copies of the relevant pages to supply the illustrations. An average number of 4,000 pages of technical articles is translated yearly by a staff of about six people, several of whom are familiar with more than one language. The files also contain detailed reports on machine tool exhibitions held in all parts of the world, drawing attention to new design features which are often illustrated by means of the manufacturers' catalogues or leaflets.

Offices for engineering staff concerned with specific fields, such as milling machines, occupy most of the remaining space above the ground floor. In the basement there are two temperature-controlled rooms in which testing and measuring equipment is installed for such purposes as checking of surface finish, and precision measurements of cutting tools. Equipment installed in this room includes the Leitz instrument shown in use in Fig. 2, for the measurement of surface irregularities, which enables readings to be made directly on a screen, or recorded photographically, if required. Other equipment includes a Zeiss toolmaker's microscope, a Hommell-Werke Perth-O-Meter surface finish measuring instrument, and a Talyrond (Taylor, Taylor & Hobson, Ltd.) roundness measuring instrument.

A small laboratory in the basement, staffed by two engineers and six technicians is equipped to produce electronic instruments of types which are not available commercially for special testing operations. There is also a well-equipped photographic dark-room in which copies of documents such as patent specifications, manufacturers' catalogues, and technical literature can be made for distribution to various Institute departments, and to factories outside. This dark-room is staffed by

Fig. 3. Work in progress in the temporary premises, occupied by the Institute until recently, included the checking of the surface finish produced at various spindle speeds on this fine-boring machine built by the Vogtland factory

women, and it may be noted that, in spite of the emphasis placed on their training for the engineering profession in communist countries, the only women on the technical staff are employed in the drawing office.

EXAMPLES OF WORK IN PROGRESS

Work carried out by the Institute, until recently in temporary quarters, has included the testing of the fine-boring machine shown in Fig. 3. Built by the Vogtland factory, of Stresemannstrasse 92, Plauen/Vogtland, this machine is one of a series of three and can be equipped with a maximum of three spindle heads which are carried on a bridge member in front of the hydraulically-powered table. Measurements were made of the surface finishes produced, and of machine vibrations and their effects, and the effects of external vibrations were also studied. Difficulties in obtaining sufficiently accurate measurements of small-amplitude vibrations have led to the development, by the Institute, of an instrument in which electrical induction is employed.

Investigations into the noise produced by various machines, including jig borers, and the effects on operators, are also undertaken. Limits for noise level, based on the work done by Slawin in Russia, are laid down for all new machines produced in East Germany. A great deal of work is concerned with the testing of prototype machines before series production is started, and one such prototype is shown under test in Fig. 4. This hydraulically-operated guillotine is being checked, with the aid of electrical strain gauges attached to the beam, by imposing forces of varying magnitude, to determine the stiffness of the frame, and the suitability of various portions of the hydraulic system.

Built by the Zeulenroda factory in Thuringia, this guillotine is designed to cut plate up to 0·25 in. thick by 6 ft. 6 in. wide, and can be operated with a short stroke when sheet of less than the full width capacity is to be cut. The machine is being tested with the aid of selsyn indicators mounted above the beam and driven by flexible cables. The selsyns are connected to a photo-recording oscillograph, and provide measurements of the actual stroke length for each operation of the beam. At the same time, the pressure rise in the cylinders is recorded on a separate instrument, and affords an indication of the stresses imposed on the system.

Work carried out on vertical broaching machines of the type shown in Fig. 5, built by the John Schehr factory at Meuselwitz, near Leipzig, has included study of the vibrations occuring in the hydraulic oil in the main cylinder during broaching operations, and means of preventing such vibration from affecting the quality of the work performed. Operation of lubrication systems on new machines; stiffness and rigidity of machine castings, such as milling machine columns; and the performances of plastics injection and extrusion machines, wire-drawing machines of new design, and hydraulic pump units, have also been investigated recently by the Institute.

Fig. 4. Electrical strain gauges attached to the beam, and selsyns connected to the beam by flexible cables, are here being employed for checking beam stiffness and the functioning of the hydraulic system on this Zeulenroda guillotine

WORK ON MACHINE DESIGN

As mentioned previously, the design and construction of each type of machine tool built in East Germany is studied by a department of the Institute and there is close collaboration between factory design teams and Institute engineers. This co-operation has been achieved during the six years that the Institute

has been in existence, but it is stated that a further 15 years may be required before the system is developed to the degree envisaged. The reductions in the number of different machine tools built by the industry as a whole, for instance, were largely achieved through the Institute, which was responsible for deciding that certain machines should be dropped, and various new designs introduced.

These changes were largely carried through as a result of persuasion, despite the fact that many factories were reluctant to give up building well established designs and enter new fields. In this connection it should be noted that the Government has power to order such changes to be made, if necessary.

At present, new machine tool designs usually originate from the Institute, where specifications are prepared in accordance with known or anticipated manufacturing demands. Details, together with patent specifications and descriptions of any design features which might be incorporated, are sent by the Institute engineer responsible, to the appropriate factory. The specification includes such information as the range of spindle speeds and feeds, standard of accuracy required, and the total cost, and sketches of suggested arrangements may also be provided.

The factory design team then prepares drawings showing details of a machine which will fulfil the specification, and these drawings are sent to the Institute and to prospective users of the machine in East German factories. Meetings are held at the Institute or at the factory concerned, at which various modifications and improvements can be discussed, and after a period varying from 9 to 18 months, according to the complexity of the design, a prototype is built. With very complex designs, the period of discussion may be prolonged up to 3 years, and the building of a prototype, which is usually carried out by the factory involved, may take from six months to two years.

In the past, it has been the policy to show certain of these prototypes at the Leipzig Fair, before they have gone into production, but this arrangement has now been changed, and only machines which are ready for sale are exhibited. Testing of prototypes may be carried out at the factories in which they are built, or at the Institute if this course is more convenient. Any modifications to the design which are found to be desirable during testing are incorporated in the machines when series production is started.

In a further article, to be published later, some details of the system of unit construction of machine tools, which is being introduced through the medium of the institute, will be given, also some examples of typical machines.

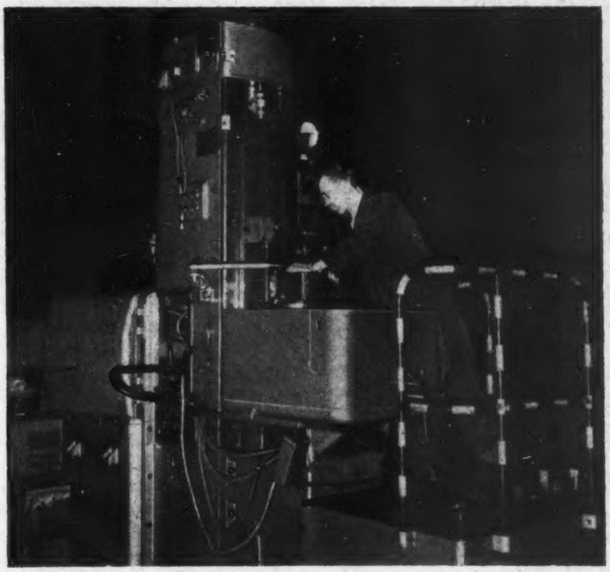


Fig. 5. Work carried out on this Schehr vertical broaching machine included a study of the effects of vibration in the hydraulic oil during broaching operations

RISING CONSUMPTION OF ELECTRICITY. Speaking at the 13th British Electrical Power Convention held recently in Eastbourne, Sir John Pickles, B.Sc., M.I.E.E., chairman of the South of Scotland Electricity Board, in his Presidential Address, stated that since the electricity supply industry was nationalized in 1947, annual sales had increased from 36,000 to more than 100,000 million units. He forecast that the present consumption would be doubled by 1970, and suggested that the 1970 figure might again be doubled by 1980 or by 1985 at the latest.

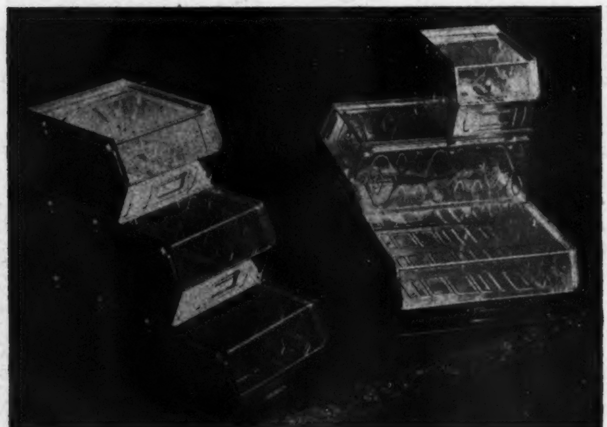
As between 1947 and 1961, the number of consumers had increased from 12 million to 17 million and the annual consumption per head from 700 to more than 2,000 units. In the same period, the capacity of installed generating plant has risen from 13,000 mW. to about 32,000 mW.

Spacesaver Unit Storage System

Bradley & Co., Ltd., Albion Works, Bilston, Staffs., have recently developed the Spacesaver unit storage system, and the range of equipment which is available includes containers of five sizes, from 13 by 12 by 8 in. high to 25 by 18 by 8 in. high. Made from steel, each container has front and rear cross-bars at the top, to facilitate movement by hand or fork truck, and can be supplied with a hot-dipped galvanized finish or stove enamelled in one of a wide range of colours, as required.

Containers of successively smaller sizes can be stacked crosswise and in line, as here shown, and when a number of units of the same size is stacked in line, the inclined open portion at the front of each allows observation of the contents and permits loading and removal of parts without the need for disturbing the arrangement. To facilitate the latter operations, a chute is available which may be readily attached to the front of a stacked container, also a clip whereby a container can be suspended from the front of a stacked unit. Longitudinal dividing plates can be supplied, which are located by separate slotted strips, and to protect the contents from dust and dirt, removable cover plates and transparent hinged front flaps can be provided.

Shelf units of two sizes, to accommodate all containers in the range, are available with hot-dip galvanized or a metallic grey finish, and provision is made for readily setting a single shelf to the mid-position, to receive containers, or a number of shelves to other positions, as may be required when storing loose components. A safety bolt assembly is available for attachment to any cross-bar of the unit, to prevent the accidental complete withdrawal of a container. Loads of ½ and 6 tons can be supported by individual shelves and the entire unit, and a number of units can be stacked without the need for bolting. Clips can be provided for fastening together adjacent stacks, when units are built to a considerable height. In connection with large installations, savings may be made by the use of bridge shelves which may be readily arranged between two stacks of units, and the latter can be connected by tie bars, if a high degree of rigidity is required. Brackets can be supplied whereby a mezzanine gangway can be supported directly by the stacked units. Cover plates are obtainable for the units, which may be readily converted into trolleys by adding castors.



Spacesaver containers of successively smaller sizes can readily be stacked, as here shown, and when units of the same size are stacked, parts are loaded and removed through inclined openings at the front

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TIN IN CAST IRON. In the annual report for 1960 of the International Tin Research Council, it is pointed out that tin in cast iron is a strong pearlite promoter. The addition of about 0·1 per cent of tin to either flake or nodular cast irons will give a fully pearlitic structure without producing massive cementite. Casting and testing of different irons with and without tin additions continued during the year, and it was found that flake iron was still free from massive cementite even when the tin content was considerably in excess of the recommended amount.

At one American foundry it is stated, where tin is used as a ladle addition, it has been found that it rapidly disperses throughout the molten metal, which has a fine pearlitic structure when cast. Variations in hardness are considerably reduced by the addition of tin, and the material is particularly suitable for such applications as automobile clutch-plates, in which uniformity of texture and smoothness in wear are important.

The Gating of Aluminium Die Castings

By H. K. BARTON

THE GATING of aluminium alloy die castings determines, more than any other die design factor, their surface finish and structural soundness. Poor gating practice results in high scrap rates, and it may be assumed, with a fair degree of confidence, that when a component is produced with a high percentage of rejects, the quality of those castings that pass inspection is likely to be only marginally acceptable. Because of the wide diversity of form, section and complexity encountered in die cast components, the selection of an appropriate form of gate for a specific casting must necessarily be largely empirical. It is therefore difficult to generalize as to the merits of particular methods of gating, since even minor modifications in the form of the casting that is to be produced may dictate considerable changes in the position and form of the gate.

Although much attention has been paid in recent years to the gating of die castings, it has, in general, been concentrated on the determination of the required cross-sectional area of the gate rather than on its optimum position; the effects of runner form, volume, and plan area upon the efficiency of the actual gate; and the modifying effects of overflows upon the flow from the gate through the cavity. These latter factors are, however, intrinsically of greater importance than the mere cross-sectional area, for whereas the size of the gate can be progressively increased without any difficulty, assuming that the feeding method is in general satisfactory, the modification of a runner that is poorly designed may entail much welding and re-cutting. Unfortunately, these basic criteria are not amenable to reduction to a formula or a graph, and runner layout, as such, still depends upon the cumulative experience of the designer.

There is no "ideal" position for the gate of any die cast part—most castings could best be fed from a point on the under-side near the centre of mass—and any position that is chosen will have some unsatisfactory features. The main value of the designer's experience is that it enables him to rule out, immediately, the totally unsatisfactory gate positions, and to mitigate the shortcomings of the least unsatisfactory position by the careful choice of runner form and the judicious use of overflows. Guidance that can most usefully be given to the less experienced designer, therefore, is of an essentially negative character. In other words, one can point out those features of gating practice which—although they are frequently seen in use—tend to result in poor quality castings and a high scrap rate.

In the present discussion, we are wholly concerned with the production of aluminium alloy die castings by conventional means. Vacuum techniques, although demanding just as much attention to correct gating practice, involve considerations that are better explored separately. Only cold-chamber methods are, of course, involved, and the gating feaures examined may, except where there is an indication to the contrary, be taken to relate to dies operating on modern machines equipped to give slow initial plunger movement, a variable-speed filling stroke, and an intensified final pressure.

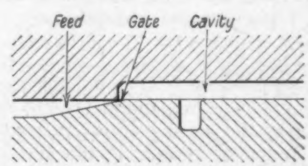


FIG. 1.

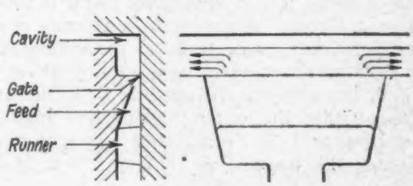


FIG. 2.

Fig. 1. Typical gate form for a flat casting
Fig. 2. When feeding into a heavy flange, metal tends to flow preferentially around the edge of the casting

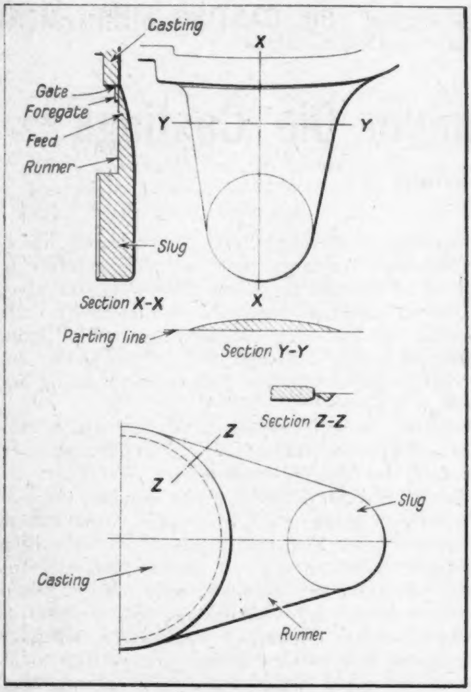


Fig. 3. A spreading runner feeding into a comparatively straight edge. The terminal flares, and the reduction of runner depth toward the sides, are particularly unsatisfactory

The major difficulty in producing sound die castings is not in getting the metal into the cavity, but in getting the air out of it. In cold-chamber machines, much of the air in the shot-sleeve, as well as that in the runners and cavity, must be expelled ahead of the advancing metal if solidity is to be achieved. Accordingly, a primary aim of gating practice must be to avoid the sealing-off of vents and overflows early in the filling phase, for once this has occurred the residual air is inevitably trapped within the casting. However high the final pressure, it can only compress—not eliminate—this trapped air.

GATING ARRANGEMENTS WHICH CAUSE EARLY SEALING OF CAVITY VENTS

If, as is often the case, a casting is so gated that metal strikes the die surface at a very oblique angle (Fig. 1) and spreads in a thin stream across it, much of the periphery of the component is sealed off before more than a small proportion of the metal has been injected. The same applies when a thin-walled casting has a bead or flange of thicker section all round it. Metal flows preferentially along the thick section (Fig. 2) and seals off all the parting-line vents before the thin-walled areas are completely filled. The fault is accentuated in both instances when runners of a spreading or "fish tail" form are adopted.

Examples of such runners are seen in Fig. 3. Their effect is to project a fan-shaped wavering jet into the cavity and, as they are frequently cut in such a way that they diminish in depth at each side (section Y-Y), flow may be extremely unstable. Metal entering the runner during the first part of the plunger stroke solidifies in the wedge-shaped extremities, so that only the central portion of the gate is initially effective. The hotter metal that follows cuts back into the chilled metal at the sides, with the result that the effective cross-section of the gate is again increased during the filling period. Control of the direction of flow within the cavity is consequently very poor, and the pattern of cavity filling varies greatly with die temperature, which determines to what extent the initial choking of the gate extremities occurs.

Some choking takes place at the ends of gates even if the section of the runner—or rather of the tapered feed—is held constant. Again, this effect is most marked with the spreading type of runner, since cold metal that has risen slowly from the shot-hole during the first part of the plunger stroke is forced outwards to the sides of the feed when the flow meets the resistance of the gate constriction. This condition can only be avoided by adopting converging, rather than spreading, runner layouts, or by extending the runner channels laterally beyond the ends of the gate to form pockets into which the chilled metal is projected.

ADVERSE EFFECTS OF CURVED RUNNERS

In practice, these two features are often advantageously combined, but before discussing examples of such arrangements it is desirable to consider further unsatisfactory types of runner layout. A flagrant example is the carrying of a runner in sweeping curves from the shot-hole to the gate, a practice to which many draftsmen are much addicted. One such layout, seen recently on a die undergoing try-out, is sketched in Fig. 4.

The die in question has two "handed" cavities for a component of approximately trapezoidal form, of such a length that the lower ends of the cavities are about level with the top of the shot-hole. As may be seen, the central portion of the runner follows a curve concentric with the shot-hole, and

reverse curves continue the channels up to the fish-tailed feeds. A section through the slug is shown on the left, and it will be noted that the runner is fed from a circular depression—the depth of which is a little greater than that of the runner itself—located opposite to the shot-hole.

Such a layout has many unsatisfactory features, the most adverse being the extent to which air is initially trapped in the runner, and subsequently carried into the cavity with the metal. This trapping occurs because the metal first forced up out of the shot-sleeve is projected around the outside curve of the central portion of the runner, as indicated in Fig. 5, until it reaches the points x, where it leaves the surface tangentially to follow the outside curves of the outer ends of the runner. Not until the tapered feed sections have filled with metal backing up from the gates does the metal from the shot-sleeve begin to flow at "full bore."

Because of the velocity gradient across a curved channel—the metal necessarily flows faster on the side having the greater radius of curvature—turbulence in a curved runner is very marked. It is clear that this principle is not well understood, because one of the commonest reasons put forward to justify this type of runner is that "it makes for smooth flow." The contrary is in fact the case, and the vorticity generated as the metal swings round the curve causes the ingestion, in the turbulent mass, of the air previously trapped. Unlike air caught up in the metal flowing along a straight channel, this air does not travel with the flow in relatively large bubbles, but is broken up into a great number of smaller ones. Moreover, because of the tendency for stagnant zones to be formed along the inner curves—the well-known "oxbow" effect—the ingested air is not carried into the cavity all at once, but continues to enter with the metal throughout the greater part of the injection phase.

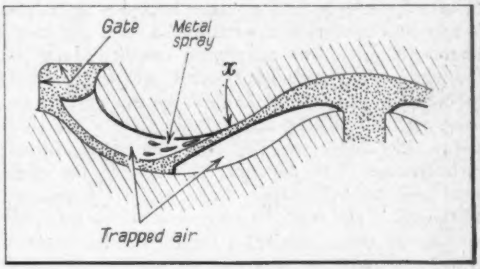


Fig. 5. Flow through the curved runner at an early phase

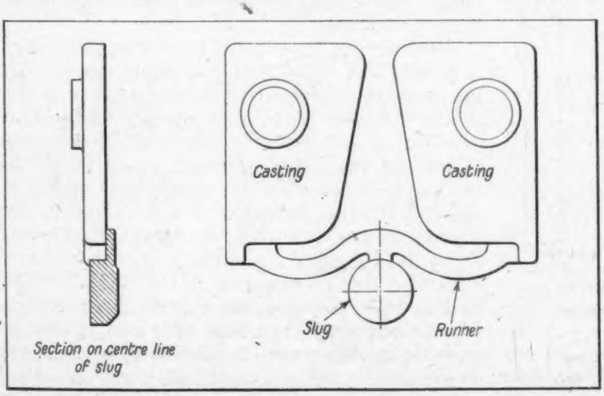


Fig. 4. This type of runner is wrongly thought to inhibit turbulence

Consequently, with runners of this kind (and much more tortuous runner channels are not uncommon) it is extremely difficult to avoid gross porosity in the component. Wherever possible, therefore, runner channels should be straight and of unvarying cross section, and where a change of direction is necessary, there should be no fairing or blending of the angles of the junction. If, for example, a runner must be turned through a right angle, it should not be milled to a radius as indicated on the left in Fig. 6, because this form results in air being trapped by the metal.

A change of direction should instead be made by carrying the main runner well beyond the point at which the turn is required, and cutting the branch runner either at right angles to it, as indicated at the right in Fig. 6, or at a slight negative angle, as in Fig. 7. The choice between the two forms depends upon the degree of pressure relief that it is desirable to incorporate in the runner system. In either case, the metal flowing along the main runner continues in a straight line into the runner extension, and not until this portion is substantially filled—and the back pressure consequently rises—does any quantity of metal pass into the branch runner.

The metal in the runner extension, of course, contains a large quantity of trapped air, which acts as a pneumatic shock-absorber. Initially, therefore, metal enters the branch runner at relatively low velocity, so that air is easily forced ahead of it through the gate, and it is not until the branch is running full bore that the whole

thrust of the injection plunger becomes operative. When this condition is established, and the metal begins to move with maximum velocity along the branch, a velocity gradient is certainly set up across the branch near the junction. By this time, however, virtually all the air carried in from the shot-sleeve has been expelled, so that the resulting turbulence is of no account. Indeed, the net effect may well be favourable, since any air remaining entrained in the metal is subjected to considerable centripetal stress and the bubbles move preferentially towards the stagnant or low pressure zone at the inside of the curve (Fig. 8).

It may appear at first sight that the same phenomenon—the establishment of a velocity gradient across the stream where it changes direction—has first been adduced as a cause of air being carried into the cavity, and then as a factor preventing air from being carried in. There is, however, no inconsistency. With curving runners static air is trapped when metal gets ahead of it, but when sharply angled runners are adopted, the static air is pushed through the channel ahead of the metal, and it is only air already entrained in the metal stream that is in question. Moreover, the angular

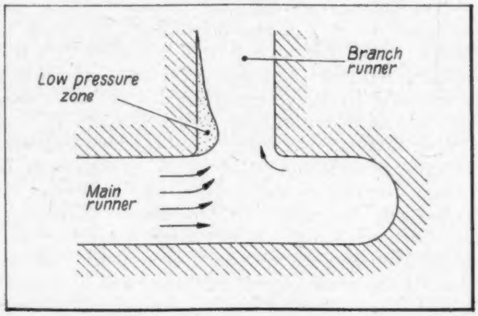


Fig. 8. The angular momentum of the metal flowing round a sharp bend induces a low pressure zone, as shown

velocity of the metal is far greater when a sharp corner must be turned, so that the centripetal force upon the air bubbles is much increased.

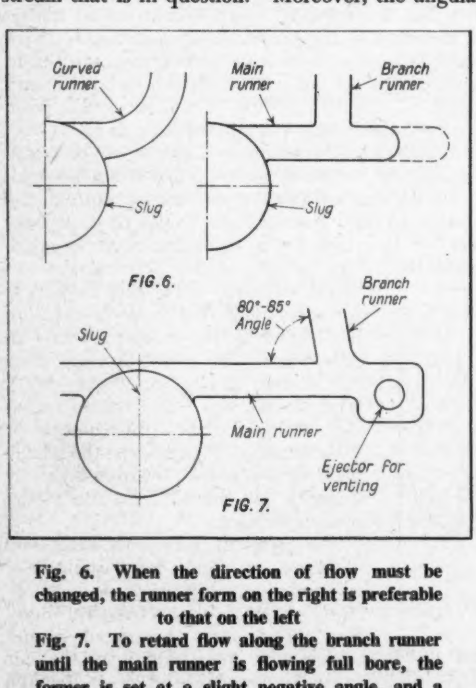


Fig. 6. When the direction of flow must be changed, the runner form on the right is preferable to that on the left

Fig. 7. To retard flow along the branch runner until the main runner is flowing full bore, the former is set at a slight negative angle, and a terminal "pressure relief" is cut at the end of the latter

DISADVANTAGES OF THIN GATES FOR ALUMINIUM

Spreading runners are usually justified on the grounds that by widening the feed section as its depth diminishes, the metal passage is not constricted progressively as the gate is approached. On this subject there are several comments to be made. The first is that the use of very wide and thin gates is a "carry-over" from zinc die casting practice where, although not desirable, it must in general be tolerated because it facilitates trimming. Under the very different conditions obtaining in the cold-chamber die casting of aluminium alloys—both metal temperature and injection pressure being much higher—shallow gates are much more undesirable.

When a thin gate is used in conjunction with high injection velocity, the metal is sprayed into the cavity in a pulsating, wavering stream. If this stream impinges immediately upon a core surface, overheating and erosion ensue, while if the metal is able to travel some distance tangential to the surface, as indicated in the upper sketch in Fig. 9, air and residual lubricant are carried with the stream into the area where the surface flow breaks down and the metal "puddles." As the turbulent mass thus formed increases in volume and moves back towards the gate, there is little opportunity for air and vapour once trapped to escape, and the unstable metal stream is continually carrying in more air.

To produce consistently sound aluminium alloy die castings, it is desirable to provide a gate of a size and form that will cause the metal to puddle

—that is, to form a mass filling the whole cross-section of the cavity—as near to the gate itself as can be ensured (lower sketch in Fig. 9). This arrangement has many advantages, the foremost being that metal passing the gate (once the puddle has filled back to the gate) cannot entrain additional air. Secondly, the efflux of the stream into the already injected metal reduces its velocity and modifies its impact upon adjacent core surfaces. Thirdly, the heat resulting from the loss of kinetic energy is carried, by reason of the strong turbulence immediately around the gate, outward into the spreading puddle.

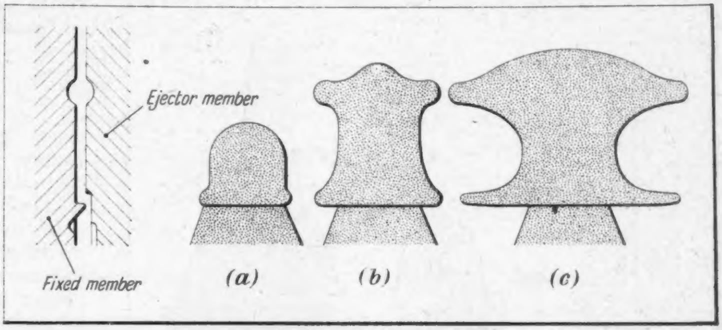


Fig. 10. Metal flow in relation to a transverse enlargement of the section

As will be evident, the velocity of the metal at the advancing edge of the puddle is very much less than that of a free metal stream projected through the cavity. As the puddle increases in volume, the size and form of the gate cease to exercise a direct effect upon the direction and velocity of the metal advancing through the cavity and the gate can accordingly be considered as a point source.* The manner in which the advancing edge of the puddle spreads is primarily determined by variations in the thickness of the cavity cross-section and the local temperature of the die surfaces.

Provided that the section variations are not such that the metal can spread preferentially around the periphery of the cavity (and this can largely be prevented even in thick-rimmed dish-shaped components, by correct gating) venting at the parting-line remains effective throughout virtually the whole of the filling phase when puddle feeding is adopted. Thus, although velocity is lost—and heat gained—in the vicinity of the gate instead of remote from it as in free stream feeding, the influx rate is not appreciably reduced since the freer venting allows the air being compressed by the expanding puddle to escape more readily from the cavity and so lowers the back-pressure. Similarly, lubricant vapours, in the main, are blown out of the cavity ahead of the metal, and solid lubricant residues are not scoured from the surface and caught up in the metal, as happens when high-velocity and partly atomized jets play tangentially across a cavity surface.

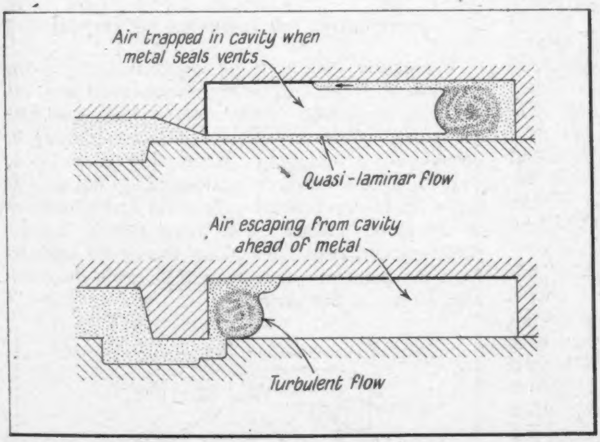


Fig. 9. Flow through a thin gate into a heavy-section cavity tends to result in the formation of a shell which then becomes filled-in from the far end. A heavier gate, placed so that the jet travels only a short distance before striking the die wall (lower sketch), results in a quick cessation of the undesirable quasi-laminar flow and the metal thereafter advances across the full width of the space between opposite die walls

The locations of gates and overflows are highly critical even when puddle feeding is employed, for since the metal advances preferentially along the lines of least resistance—that is, generally, through the largest

* Barton, H. K., "Effect of Cavity Proportions upon Metal Flow," MACHINERY (London), January 25, 1957.

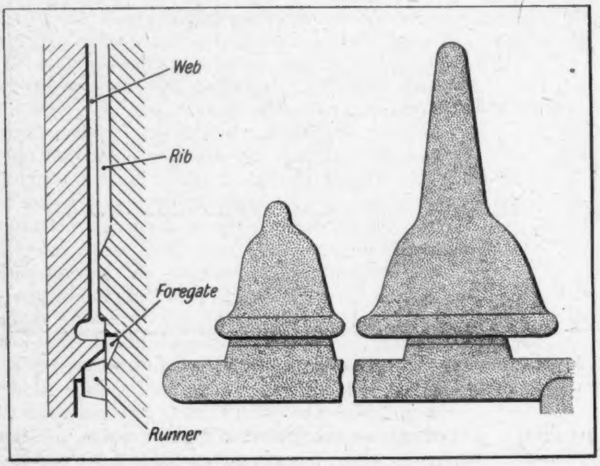


Fig. 11. The effect of a rib or bead placed in the direction of flow

sections—air locks are formed if unfilled areas are cut off. Such an air lock may occur, for example, if the metal is able to advance along a pair of heavy rib impressions and merge at the far end.

EFFECT OF RIBS ON METAL FLOW IN THE CAVITY

The orientation of ribs and other features involving local changes of section, in relation to the gate, is accordingly of primary importance. If the advancing edge meets a heavy rib section transversely, as in Fig. 10, the effect is to retard, momentarily, the forward movement as metal flows laterally along the rib, but the sideways movement through the thin section on the near side of the rib continues. Feeding into the rib thus proceeds on a widening front, to increase the lateral flow rate within the rib and straighten out the advancing metal front in the thin section on the far side of the rib. This effect is indicated by the sketches *a*, *b*, and *c* in Fig. 10.

If the advancing edge, moving through a thin section, encounters the end of a heavy rib cavity disposed radially, as in Fig. 11, flow again occurs preferentially along the rib, but the outward flow from the rib on both sides increases with the length of the rib filled, as shown in the figure. Whether one type of flow is to be preferred to the other depends upon the overall form of the component, and cannot be arbitrarily determined. The actual extent to which ribs and similar features modify flow is, of course, controlled by their shapes and cross-sectional areas.

In order to prevent flow along ribs resulting in air-locks, it is desirable that the rib section should be slightly thinner than the adjoining web, and this relationship is also to be preferred on other grounds. When heavier ribs are necessary for structural reasons, they should preferably be faired off into the wall at both ends, in the manner indicated in Fig. 11, rather than carried to the edge of the component. Such fairing is particularly desirable if the edge of the casting has a heavy bead into which the far end of the rib would feed. However, these are points for the consideration of the product designer rather than the die designer, and the latter can obtain a satisfactory filling pattern even for components embodying unsatisfactory features by careful attention to gating and feeding.

HEAVY GATING FOR ALUMINIUM DIE CASTINGS

For puddle feeding to be achieved, heavy gating is essential. For it to be effective, correct positioning and orientation of the runner, feed, and gate are equally necessary—the two factors cannot be considered in isolation. Wide, thin gates, as in Fig. 12, even if correctly positioned, do not give an initial build-up of metal within the cavity adjacent to the gated portion. The metal merely changes direction and runs back along the cavity surfaces from the point of impingement, blocking the vents well ahead of the main fill.

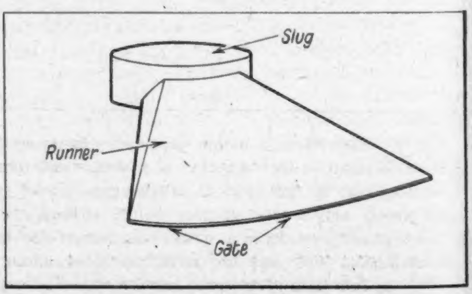


Fig. 12. Gates of this type are seldom satisfactory for aluminium alloy die castings

Fig. 13. Direct (Polak-type) feed into the web of a casting

Fig. 14. Feeding into a boss is more frequently adopted

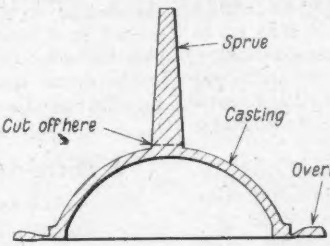


FIG.13.

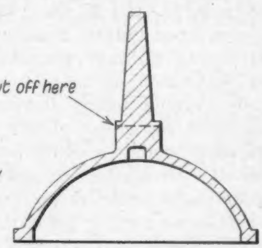


FIG.14.

It must be remembered that the use of a gate—in the sense of an imposed constriction of the flow where the runner joins the casting—is by no means essential to the production of an acceptable die casting. Many components, even of thin section, are satisfactorily produced on Polak-type machines by direct feeding—that is, with the tapered sprue-hole opening directly into the cavity as in Fig. 13. The sprue metal is cut off short and, if necessary, the base is ground flush with the remainder of the casting surface. It is, however, common for designers well experienced with such machines to revert to outside gating for a component like that shown, whereas they would have no hesitation in gating into even a shallow boss, as in Fig. 14. Operationally, of course, there is no difference whatever between the two castings. The solidity of Polak sprues is noteworthy and the point at which they are subsequently cut from the casting is of no importance from the cavity-filling standpoint.

There is thus no disadvantage to heavy gating apart from the increased difficulty of separating the runner-metal from the casting, and since many aluminium die castings must be band-sawn (see Fig. 15) even if wide and relatively thin gates are provided, major objections can only arise when the gate form is such that all the runner metal cannot be removed with a band-saw. Such a situation arises, for example, when an upward gate into the rim or flange of a component is adopted, on the lines indicated in Fig. 16. When a part gated in this way is bandsawn, a solid stub is left on the underside of the casting. For this reason, designers frequently avoid what, for many components, would be the best type of gate.

Nevertheless, it is always unwise to sacrifice casting quality for ease of trimming, and there are welcome signs that die casters are becoming more willing to mill runners from the casting instead of sawing them off. In the case of parts gated as shown in the figure, it may be an advantage to mill the whole flange surface, thus eliminat-

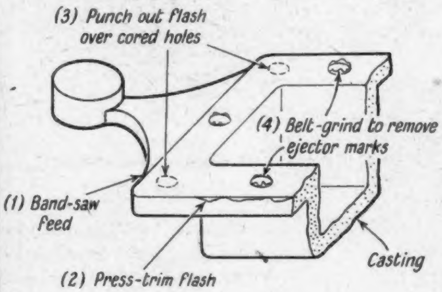


FIG.15

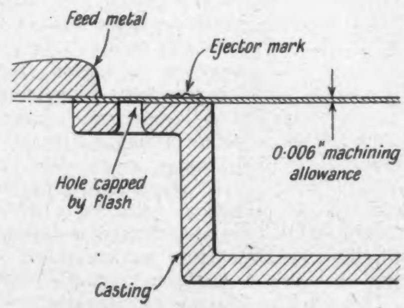


FIG.16

Fig. 15. Four secondary operations are required on this die cast aluminium housing

Fig. 16. All four operations may be replaced by taking a milling cut all over the flange surface as shown. Milling also corrects distortion and gives improved dimensional accuracy since compensation is made for variations in flash thickness by the depth of cut taken

ing not only the band-sawing, but also any belt- or wheel-grinding operation required to remove ejector marks. On modern rotary-table equipment, with fixed cutters rotating at speeds up to 10,000 r.p.m., milling operations of this nature can be performed on several hundred parts per hour. For profile milling, to remove runner metal and fins from the edges of irregular die castings, outputs may be only slightly lower.

There is, therefore, no insuperable obstacle to-day to the gating of die castings in aluminium alloy with primary regard for the soundness of the casting and the speed of production achievable, rather than ease of trimming. Ease of filling, and control of the direction of flow and the rate of fill, are then the factors with which gating and runner lay-out are essentially concerned. Here they have been considered only in the broadest way, but at a later date it is proposed to deal with specific runner layouts and gating methods in some detail.

Morgan Type BT. 1300 Basin Tilter Crucible Furnace

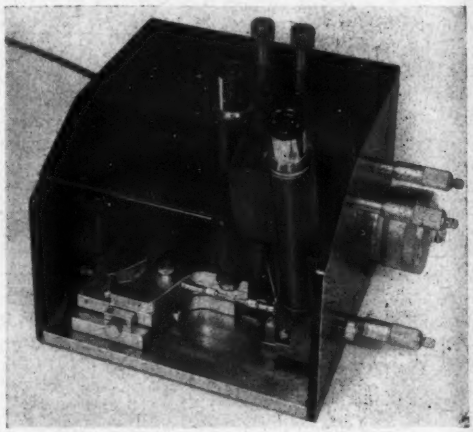
The type BT. 1300 basin tilter crucible furnace shown in the illustration, has recently been placed on the market by Morgan Crucible Co., Ltd., Battersea Church Road, London, S.W.11, and is similar in design to the company's type BT. 380 and type BT. 500 furnaces.

This new furnace is particularly intended for use in the die casting industry for supplying bale-out furnaces, and will take a maximum charge of aluminium, weighing 1,300 lb., which can be melted in 1 hour. It has a low platform, and a large-diameter crucible, which facilitates charging bulky metal scrap, and provision is made for variable speed control of the tilting motion.

Morgan type BT. 1300 basin tilter crucible furnace

A Micro-tensile Testing Machine

Techne (Cambridge), Ltd., Duxford, Cambridge, have acquired the manufacturing rights for the bench-mounted micro-tensile testing machine shown in the figure, which has been developed by the Research Laboratories near Cambridge of Tube Investments, Ltd., The Adelphi, London, W.C.2, for testing single crystal "whiskers" and other items which may have a length of only 0·5 mm. (0·02 in.), and cross-sectional areas ranging from 10^{-2} to 10^{-7} sq. mm. (2×10^{-5} to 2×10^{-10} sq. in.).



Testing machine for single crystal whiskers

The machine incorporates a torsion balance which enables loads ranging from 1 mgm. up to 400 gm. to be applied to the specimen. Increases in length of the specimen ranging from a few Ångstrom units up to 15 mm. are detected by an auto-collimator, and are measured, usually to an accuracy of 100 Ångstrom units, by a sensitive micrometer, which operates through a system of levers. In certain instances readings have been repeated to within 5 Ångstrom units (0·00000002 in.). The machine can be readily arranged for compression testing, for testing of thin films, and for carrying out tests in special atmospheres.

Machine Tools at the Soviet Exhibition

By R. E. GREEN, Associate Editor

An article published in MACHINERY, 99/161—19/7/61, described the two largest Russian machine tools on view at the Soviet Exhibition, which is to continue until July 29. Some other machines displayed are here considered.

PROGRAMME-CONTROLLED FINE-BORING MACHINE

The type 2706 fine boring machine shown in Fig. 1 is built by the Odessa radial drilling machine works, and is of conventional construction with bridge castings to carry the spindle heads and a hydraulically-operated table for the fixtures. Each bridge member can accommodate up to four spindle heads—according to width—from the range of four different sizes, and bores from 0·39 to 7·87 in. diameter can be machined. Spindle speeds of 1,000, 2,000, 3,000 and 5,000 r.p.m. are available, the heads at each end being driven by separate motors, which are of 3·75 h.p. on the machine shown. Hydraulic power is provided by a motor-driven pump, housed in the base, and the table feed can be varied between 0·39 and 38·38 in. per min.

Normally the machine operates on an automatic cycle which includes rapid traverse towards the tools at one side, movement at the set feed for boring, and rapid return to the central position, unloading and reloading of fixtures at the other side of the table being carried out during this time. Alternatively, the table may be caused to travel first to one set of tooling for rough-boring, and then to the other set for finishing, or to move in the two directions in succession for operations on different bores. All these movements are selected by the insertion of contact plugs in sockets in a board at the rear of the machine, as seen in Fig. 2. This board is normally covered by a glass-panelled door, and it provides for the selection of a maximum of 10 successive movements in any one machine cycle.

The rows of sockets are labelled and they provide for movements of the table in either direction, at rapid or feed rates, starting and stopping of the spindles at either end of the machine, and a dwell period. There is also provision for stopping the machine at the end of the cycle, and for repeating the cycle from a particular point, for instance, for reboring a hole to allow for spring in the tool, or for indexing a fixture.

On the machine shown, the fixture is designed to hold two cast iron diesel engine fuel pump components, in each of which four holes of approximately 1 in. diameter are to be bored, to form the pump cylinders. These castings are located on the vertical face of the fixture, at the right in Fig. 1, by means of dowels which enter holes near each end, and are secured by three lever-type clamps, held on the rams of horizontal hydraulic

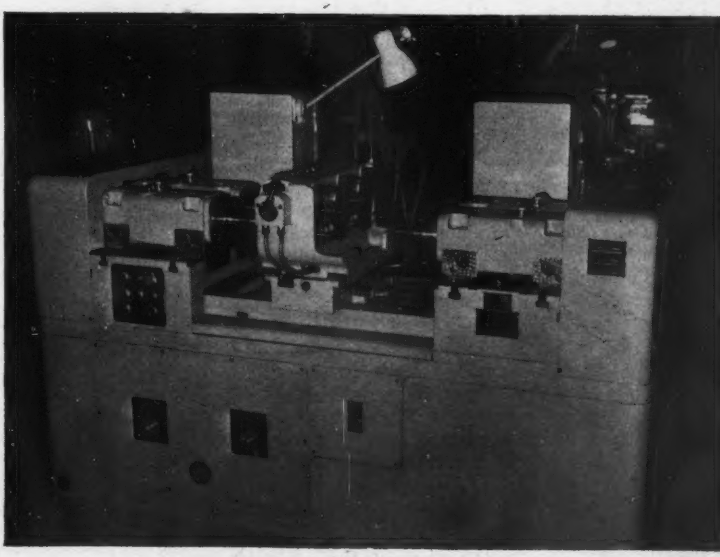


Fig. 1. General view of the type 2706 programme-controlled fine boring machine built by the Odessa radial drilling machine factory, which can be fitted with a maximum of four spindles at each side of the central table

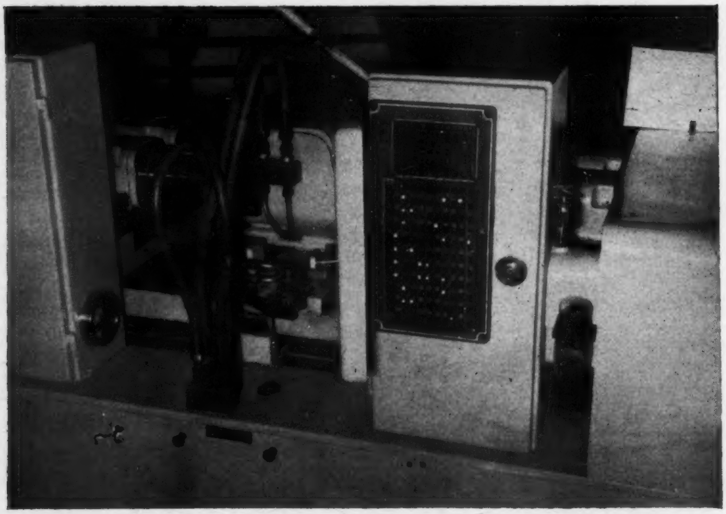


Fig. 2. The cycle of the 2706 fine borer is controlled by means of this socket board into which plugs are inserted to complete electrical circuits for the operation of relays and solenoid valves in the hydraulic system

cylinders in the fixture. These rams have cam grooves which are engaged by fixed pins so that the clamps are turned through an angle of about 90 deg. as they are retracted and advanced, to carry them clear of the castings for loading and unloading.

Force is applied by the clamps to the ends of the castings, at the dowel pin positions, the centre clamp being fitted with a pivoted beam which engages the adjacent ends of two castings. The fixture is carried on a slide, supported on guideways arranged at 90 deg. to the direction of table traverse, and it is moved in succession to four positions, for the boring operations, by a hydraulically-operated system. After the work has been loaded and clamped, the automatic machine cycle is started by pressing a button at the front of the machine, and the fixture is then moved to the limit of its travel towards the front of the table.

The table is next moved to the left at rapid traverse speed, the left-hand spindles are started, and as the work approaches the tools, the feed is reduced to the pre-set rate. At the end of the rough boring operation, the spindles are stopped and the table is rapid-traversed to the right, where a similar sequence is followed for the finish-boring operation. As the table subsequently returns towards the central position, a pawl on a bracket fixed to the machine bed at the rear turns an 8-tooth pinion on the end of a shaft projecting from the rear of the fixture guideway casting. This pinion is held in position by a spring-loaded grooved detent, and its shaft also carries a collar with flat surfaces on opposite sides.

As the gear is turned, the circular portion of the collar moves into a position in which it pushes downwards on a nearly horizontal, centrally-pivoted lever. The other end of this lever is thus raised, to push up a plunger in a valve block, and thus change the direction of the oil supply to the indexing cylinder so that the fixture moves towards the rear. Travel is limited by the first of four stops on the shaft

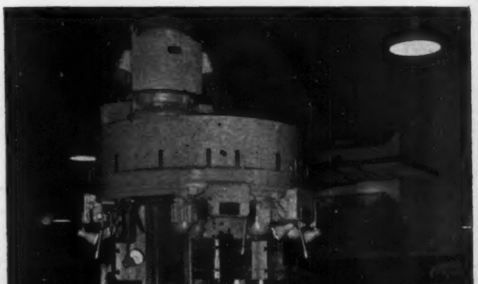


Fig. 3. On this type 1283 8-spindle vertical chucking automatic, control of the rapid traverse and feed motions of the slides is effected by means of punched cards, fitted to drums which are turned as the slides move

carrying the gear, and the fixture is thus located in the required position for rough- and finish-boring of the second hole in each casting. The machining and indexing cycles are then repeated for the remaining holes, and the machine is eventually stopped automatically for unloading, with the table central and the fixture at the rear.

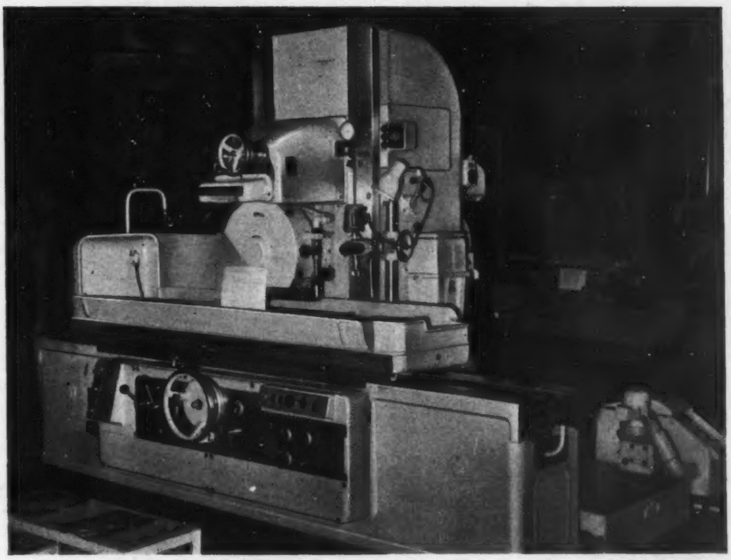


Fig. 4. This type 3722, horizontal-spindle surface grinder, built by the Moscow grinding machine works, will accommodate work up to 15·75 in. high above the table, and can be operated on an automatic cycle

EIGHT-SPINDLE VERTICAL AUTOMATIC CHUCKING LATHE

The type 1283 8-spindle vertical, automatic, chucking lathe, shown in Fig. 3, is an improved version of an established design for the range 4-, 6- and 8-spindle machines of this type, made by the Krasnoi Proletarii factory in Moscow. The machine has a nominal capacity for blanks up to 12·6 in. diameter, but larger components can be handled if necessary. There are 35 spindle speeds ranging from 50 to 800 r.p.m., which are obtained with change gears, and each spindle can be driven at a different speed if required. Power is supplied by a main motor of 134 h.p.

For indexing the table there is a Geneva mechanism, and it is located with the aid of wedge-shaped projections on the periphery, which are engaged by a V-grooved block advanced by a hydraulic cylinder. By arranging the locating mechanism on the table edge, it is claimed, maximum accuracy of positioning is ensured. Hydraulic pressure, supplied from a pump unit driven by a motor of 13·4 h.p., is also employed for the operation of the chucks, and for relieving the weight of the table during indexing, also for the operation of the spindle-driving clutch.

Each of the seven machining slides has a separate rapid-traverse motor, which is controlled during setting operations by a joy-stick lever at the side of the unit above. A range of feeds from 0·0012 to 0·139 in. per spindle rev. is obtainable with change gears, and the feed rate can be doubled during the cutting traverse, if required. Control of the points at which the changes are made from rapid traverse to the feed rate, and from one feed rate to the other, for each slide, is effected by means of a flanged brass drum in a housing above the slide. This drum is connected to the slide so that it is turned as the slide moves, and it is fitted with a punched card.

Electrical contacts adjacent to the drum periphery rest on the card surface, which acts as an insulator, but when a hole in the card passes one of the contacts, of which there are three, an electrical circuit is completed to a relay which stops the fast traverse motor or operates a magnetic clutch to change the pre-set feed rate. Each slide has a total traverse of 13·78 in., for turning or boring operations, and special slides operated through racks and pinions can be fitted for facing work. Multi-spindle drilling heads and milling units can also be fitted to the machine if necessary. At the exhibition, the machine is set up for operations on commercial vehicle engine flywheel blanks, but no actual cutting is being done.

With a total weight of 19·5 tons, the machine occupies a floor space of 11 ft. 7 in. by 11 ft. 1 in., and is 12 ft. 10 in. high.

Built by the Moscow grinding machine works, the type 3722, horizontal-spindle surface grinder, shown in Fig. 4, closely resembles the type 3A 732,

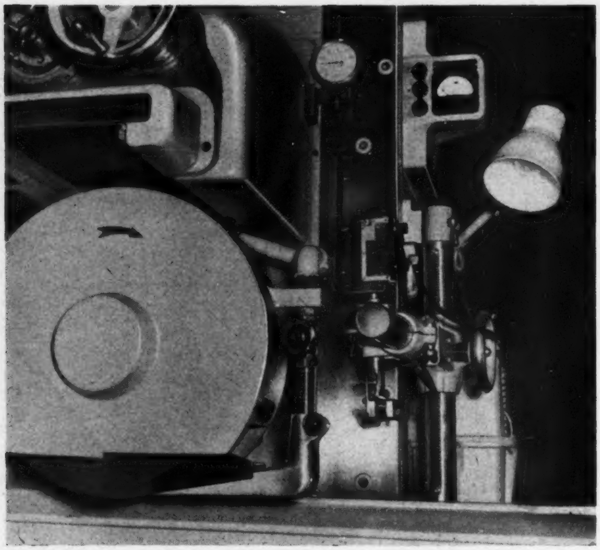


Fig. 5. The automatic cycle of the type 3722 surface grinder is controlled by means of this gauging unit, which is mounted on the side of the column, and can be adjusted both vertically and horizontally

vertical spindle machine shown at the recent Leipzig Fair (MACHINERY, 98/1198—24/5/61). Workpieces with plan dimensions up to 12.6 by 39·4 in., and heights up to 15·75 in., can be accommodated. The grinding wheel is mounted on the spindle of the 13·4-h.p. driving motor, which is carried in horizontal ways in the vertical slide casting, movements in both the horizontal and vertical directions being automatically controlled.

There is a choice of 10 vertical feed increments for the wheel-head, ranging from 0·0002 to 0·002 in., also rapid traverse in the vertical direction at 16 in. per min. Feed increments may be applied manually or automatically, under the control of a measuring unit mounted on the right-hand side of the column, as seen in Fig. 5. This unit can be adjusted vertically and horizontally to suit the position of the control surface on the component. During an automatic cycle, the wheel-head is lowered at the rapid traverse speed to a pre-set height, and roughing feed increments are then applied at each reversal of the cross-traverse motion.

During this roughing stage, the height of the work is measured by the instrument, and when it reaches a pre-set value the feed is changed to 0·0002 in. increments for finishing. The table is reciprocated hydraulically, at speeds which can be steplessly varied between 6·5 and 131 ft. per min. Steel strips are fitted to protect the table ways from abrasive, and the column ways are enclosed by telescopic covers. Coolant is delivered to the wheel housing by a separate pump unit, and is

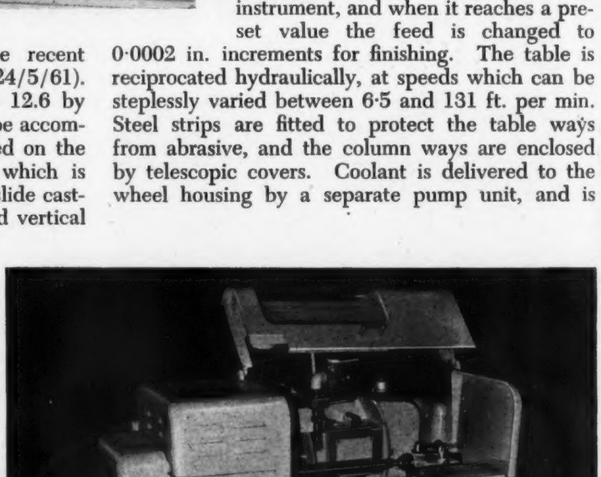


Fig. 6. Built by the Moscow jig boring machine factory, the type 5822 universal thread grinder can be employed for operations on gauges, screws and worms, flat and circular thread chasers, racks, and form tools, also for form relief grinding taps, hobs, and thread-milling cutters

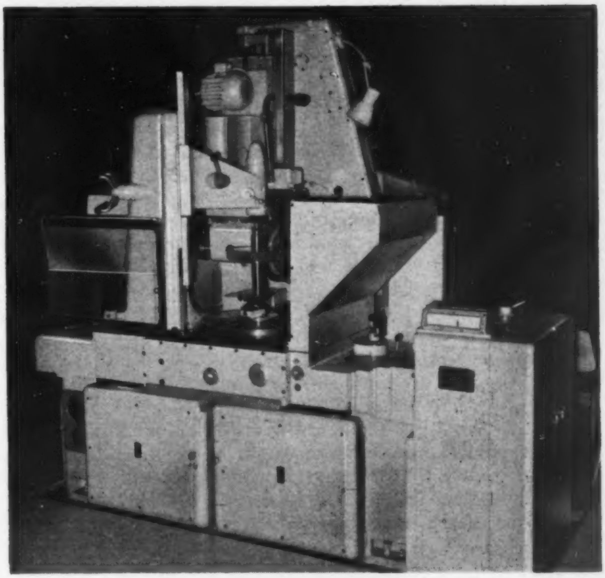


Fig. 7. Designed and built by the ENIMS research institute, this type 584M machine provides for grinding straight and helical spur teeth on gears from 2·362 to 19·68 in diameter, by a generating method

passed through a magnetic separator and filter unit before being recirculated.

UNIVERSAL THREAD-GRINDING MACHINE

The type 5822, universal thread grinder seen in Fig. 6, which is built by the Moscow jig-boring machine factory, has a capacity for external threads up to 7·87 in. diameter and admits a maximum length of 19·68 in. between centres. A variety of work can be ground on this machine, including thread gauges, screws and worms, flat and circular thread chasers, racks, and form tools, and it may also be used for form-relieving taps, hobs and thread-milling cutters. Either single- or multi-ribbed wheels, of a maximum diameter of 15·75 in., and a face width of 0·39, 0·78 or 1·57 in. can be employed. The spindle is driven by a 6-h.p. motor, and there is a choice of six speeds from 1,430 to 2,860 r.p.m.

There is an automatic diamond dressing device for producing the required form on the wheel, and automatic compensation for the material removed is made by advance of the head. When multi-rib wheels are employed for grinding short workpieces, the wheel-head can be plunge-fed on an automatic cycle.

The work-spindle is driven by a 0·6 h.p., d.c. motor, supplied from a motor-generator set, which provides steplessly-variable speeds from 0·3 to 45 r.p.m. During the rapid return motion of the table, the work-spindle is driven at 100 r.p.m. Change gears determine the pitch of the thread ground, and there is a special mechanism on the table which provides for fine adjustment of pitch by means of a micrometer screw. This mechanism enables the pitch obtained from the change gears to be varied within ± 25 per cent of the nominal value, when threads of extra high accuracy, of great length, or of non-standard pitch are to be produced.

External English threads from 3 to 28 or 5 to 28 per in., and metric pitches of 0·25 to 60 and 0·75 to 4 mm., may be ground with single- and multi-ribbed wheels respectively. The maximum depth is 0·708 in., and multi-start threads with a maximum of 48 starts can be ground, the limiting helix angle being 15 deg. in either direction. For relief grinding, the amount of relief can be varied from 0·0008 to 0·1575 in., and the number of lands may range from 2 to 18.

Internal threads can also be ground, by means of an attachment which is mounted on machined and scraped surfaces at the front of the wheel-head, in bore diameters from 0·98 to 4·9 in., and with lengths up to 2·95 and 2·16 in. for single- and multi-ribbed wheels. Pitches of internal threads may range from 0·019 to 0·236 in. for single- and from 0·039 to 0·118 in. for multi-ribbed wheels, and the helix angle is limited to 8 deg. in either direction. External and internal tapered threads can also be ground on the machine.

For trapezoidal form threads pitches may range from 0·078 to 0·2362 in. and from 0·078 to 1·57 in. with single- and multi-ribbed wheels. A special fixture is available for grinding large helix angle worms without distortion of the profile, and square threads may be ground with the internal attachment. Coolant supply equipment, including a motor-driven pump and filter, is built into the machine. The overall dimensions are 7 ft. 9 in. by 6 ft. 7 in. by 4 ft. 10 in. high, and the machine weighs about 3·9 tons.

Built by the ENIMS research institute, the type 584M, semi-automatic gear grinding machine,

shown in Fig. 7, is intended for grinding straight and helical tooth gears by the generating process, using a single-ribbed wheel which operates on adjacent flanks of two teeth simultaneously. During the grinding operation, the wheel is reciprocated vertically and plunge fed to a stop while the gear is rolled slowly past it, in mesh with the profile. After a tooth space has been ground, the wheel-head moves back and the work is returned to its original position, while continuing to rotate in the same direction as during grinding.

With this arrangement the work is indexed through a number of tooth spaces which is not a factor of the number of teeth in the gear, and differential indexing is avoided.

Gears of 2·362 to 19·68 in. diameter, with face widths up to 7 in., and of 2 to 10 mm. module (12·7 to 2·54 d.p.), with numbers of teeth from 8 to 150, can be ground on the machine. The wheel is driven from a 0·75-h.p. motor mounted on the slide, through a flat belt, at a speed of 2,200 r.p.m., and the column can be set over to any angle up to 45 deg. by means of a mechanism at the rear, as seen in Fig. 8, in conjunction with a scale and vernier. The number of strokes of the slide carrying the wheel spindle can be varied from 34 to 268 per min., and the number of tooth spaces through which the work is to be indexed is set on a small dial at the lower right-hand side in Fig. 8.

Wheel dressing is performed by means of a unit with three diamonds, which is operated automatically, either after a number of passes, or when a push-button is pressed. The diamonds can be set so that two or three are brought into operation at the same time, and compensation for the material removed is made automatically. The machine operates on an automatic cycle and stops when all the teeth of the gear have been ground. It measures 8 ft. 4 in. by 7 ft. 6 in. by 7 ft. 7 in. high, and weighs approximately 6 tons.

Importation of Russian-built machine tools into this country is being handled by United Machinery Services, Ltd., 4-7 Burford Road, London, E.15, and Machine Tool Agencies, Ltd., 79 Portland Place, London, W.1.

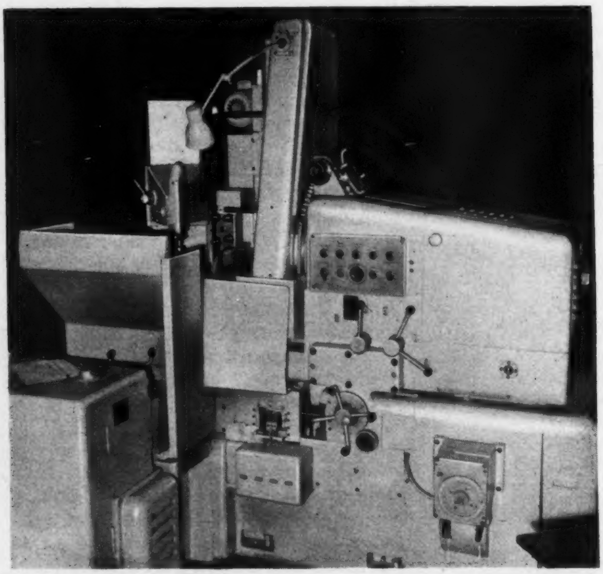


Fig. 8. In this view from one side of the type 584M machine may be seen the angular adjustment mechanism for the column, which can be set at angles up to 45 deg. on each side of the vertical

THE NEED FOR CONSISTENT TESTS FOR NOISY MACHINES. Because human judgment of excessive machine noise is unreliable, D.S.I.R. scientists at the National Engineering Laboratory are prepared to develop instruments to ensure consistent standards of inspection.

The need for such instruments was emphasized by recent experience in an electric motor factory, where inspectors were rejecting 25 per cent of the motors in a batch, and it was discovered that they agreed about fewer than 10 per cent of the rejects.

In previous attempts to standardize tests for noise, sound meters have sometimes been used, but where such a meter registers the total volume of noise, regardless of its source, it is of little help for the purpose. Experience has shown that certain parts of a machine are usually responsible for noise in a particular frequency range. For example, noise in the bearings of an electrical machine occurs in the frequency range 1,000-1,200 c/s, and electrical noise in the range 100-160 c/s. In the N.E.L. instruments, the usual microphone and amplifier will be combined with suitable filtering circuits, to measure noise levels in different frequency bands. Thus, it should be possible to identify the source of noise in the type of machine for which the instrument was designed.

British Welding Research Association

A new Engineering Laboratory was formally opened recently at the Abington Hall premises of the British Welding Research Association by the Rt. Hon. Lord Mills, P.C., K.B.E. The ceremony was performed during one of the open days, which afforded visitors an opportunity of seeing something of the work that is being carried out by the Association in connection with various aspects of welding.

Of 2-storey design, the new laboratory is intended to replace a number of recently-vacated buildings at the Abington Hall site, and various offices are provided on the first floor, which has an area of 8,000 sq. ft. There are no dividing walls on the ground floor of the building, which covers an area of 15,000 sq. ft., and houses a machine shop, a welding shop, and equipment for carrying out investigations in connection with resistance welding, brittle fracture, and pressure vessels. Machines with ratings of 700 and 2,000 tons, which have been in use in other laboratories at Abington Hall for some time, for carrying out tensile tests on steel plates up to 3 in. thick, have been transferred to the new building. Another machine which has a rating of 4,000 tons is being developed for carrying out tensile tests on mild steel plates up to 36 in. wide by 6 in. thick, and alloy steel plates up to 4 in. thick.

Work is in progress in the new laboratory on measurement of the temperature cycle during spot welding, with the object of determining the amount of post-weld heat treatment that is necessary to prevent brittleness in the work. For this investigation, alumina thermo-couples in the form of very small wires are employed, which are mounted vertically in the electrodes on the spot welder, or between the plates to be welded, and temperature variations are indicated on a high-speed ultra violet galvanometer or an oscilloscope. It is reported that in some instances the thermo-couples have melted within the weld "nuggets" which indicates that the peak temperatures reached in the work are at least 2,000 deg. C.

With conventional seam welding, the current is switched on and off at very short, regular, intervals, to produce a series of overlapping welds. Although satisfactory welds are obtained by this procedure in many steels, cracking sometimes results when it is employed for high alloy stainless steels. Investigations so far carried out have shown that cracking is eliminated when a continuous a.c. supply is employed for welding such steels, and it appears that the conditions for welding are then less critical than those for welding with an interrupted current. It is stated that work in this field will be continued.

FRICTION WELDING MACHINE

Although patents in connection with friction welding were granted in this country as early as 1941 and 1942, much development in this field appears to have taken place in Russia and Czecho-

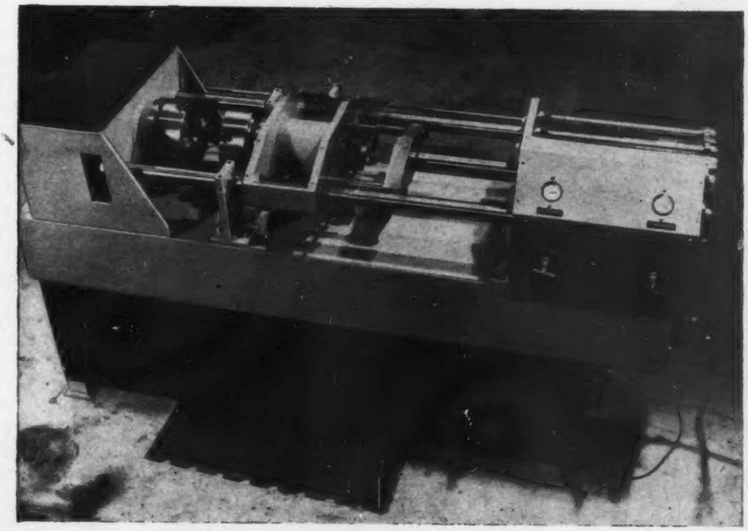


Fig. 1. This friction welding machine has recently been built by the British Welding Research Association

slovakia during recent years, and some work which has been undertaken in the latter country was discussed in MACHINERY, 97/892—19/10/60. The machine shown in Fig. 1 has recently been built by the British Welding Research Association, for carrying out investigations on friction welding, and was available for demonstration during the open days.

As was explained in the earlier article, friction welding is a form of pressure welding in which two workpieces to be joined are held in contact and rotated relative to each other. Due to the rotation, the joint faces become heated, so that the metal is brought to a plastic condition, whereupon the contact pressure is increased to complete the weld.

It is stated that the friction welding process has some of the advantages of the more commonly-known resistance welding processes, and requires less power.

The B.W.R.A. machine has a capacity for friction welding mild steel bars of cross-sectional areas up to 1 sq. in., and has two 4-jaw chucks for holding the pieces to be joined. Drive to the spindle which carries the left-hand chuck is taken from a 10-h.p. motor, through a timing belt, and spindle speeds of 430, 640, 800 and 1,200 r.p.m. can be obtained by means of interchangeable stepped pulleys. When the driving motor has been started at the beginning of the working cycle, the spindle housing for the right-hand chuck is advanced on cylindrical guide bars, by a 12-in.

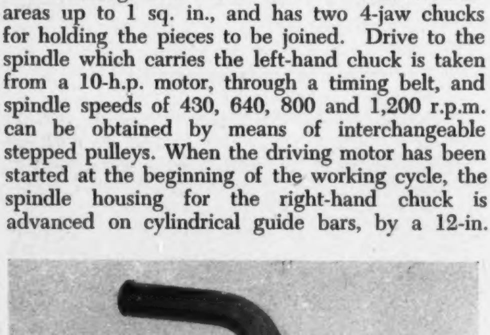


Fig. 2. The bottom view shows two ¾-in. diameter mild steel bars which have been joined by friction welding. Other ¾-in. diameter friction welded mild steel bars on which tensile and bending tests have been carried out are seen in the centre and at the top

diameter double-acting air cylinder, to bring the ends of the component pieces into contact with each other for welding. During the pre-heating stage of the welding cycle, the spindle for the right-hand chuck is prevented from rotating by an arm secured to its right-hand end, which makes contact with a stop. At this stage, due to the heating of the workpiece metal, some upsetting takes place, and the spindle housing continues to advance on the guide bars under air pressure which is maintained at both sides of the piston. When the metal has been brought to the plastic condition, and has been upset by a pre-determined amount, a pusher bar at the rear of the bed, which is connected to—and travels with—the spindle housing, operates a micro-switch. As a result, air pressure at the piston rod end of the cylinder is released and the upsetting force on the component parts is increased. At the same time, the stop is brought clear of the end of the arm by means of a solenoid, so that the right-hand spindle and the welded workpiece can rotate with the left-hand spindle. In addition, operation of the micro-switch causes a brake to be applied to stop the driving motor.

The right-hand spindle runs in a taper roller bearing at the nose end and a cylindrical roller bearing at the rear end, and it is stated that no twisting takes place in mild steel bars down to ⅜ in. diameter when the stop is moved clear at the end of the welding operation. When compressed air at 100 lb. per sq. in. is delivered to the cylinder, a maximum upsetting force of 5 tons can be applied to the component parts being welded.

At the bottom in Fig. 2 may be seen two ¾-in. diameter mild steel bars which have been joined by friction welding on the B.W.R.A. machine. At the centre and top are shown other ¾-in. diameter friction welded bars on which tensile and bending tests have been carried out.

Books Received

WOMEN ENGINEERS IN THE U.S.S.R. Report by L. S. Souter, B.Sc., A.R.T.C., A.M.I.E.E., M.W.E.S., and R. Winslade, M.S.I.T., M.W.E.S. The Caroline Haslett Memorial Trust, 25 Foubert's Place, London, W.1. 28 pp.

This informative report which was recently presented gives the results of a study tour by the authors under a travelling exhibition awarded by the General Section of the trust. It includes sections under such headings as: education system of the U.S.S.R.; history of the entry of women into engineering; distribution of women in various types of engineering; lower technical qualifications; do women make good engineers?; mental attributes; physical attributes; economic factors; social factors; marriage and domestic responsibilities; and acceptance.

NEWS OF THE INDUSTRY

The Midlands

E.M.B. Co., Ltd., Moor Street, West Bromwich, Staffordshire, report that the output of die casting machines from their works last year was the greatest they have yet achieved. The No. 16 die casting machine, which is shortly to be demonstrated, is intended for cold or hot chamber working, and has a locking force of 225 tons. It is designed for high-speed operation under automatic control and may be employed for single cycle or continuous working.

E.M.B. electrical equipment continues to be in strong demand from the home and overseas markets and we may note that the company has recently provided controllers for grabbing cranes destined for Russia. An order has also been received for E.M.B. controls incorporating Microsen speed variation equipment for 14 overhead travelling cranes required for installation in a vehicle factory.

The facilities in the works have been improved by the provision of a water-wash paint spraying booth, and the addition of a department for the production of sheet metal assemblies. Gradual replacement of machine tools and workshop equipment during the past seven years has resulted in a general improvement in production efficiency.

Tay Tool Works, Ltd., Spon Lane, West Bromwich, are busy with the production of Fellows type gear shaper cutters and Cornelis type thread generating cutters. Orders for such cutters are being received by the company on an increasing scale, and we are informed that deliveries to export markets are tending to rise.

Midland Machine Tool Co. (Birmingham), Ltd., Spon Lane, West Bromwich, are well placed for machine tool rebuilding work and in this connection we may note that facilities are provided for restoring centreless grinding machines, thread rolling machines, and universal grinding machines, for example, to the original limits of accuracy. Contract machining of close tolerance parts is also undertaken, and we understand that there has been a steady expansion of this side of the business. Additional machine tools have been installed including a Colchester Mascot 8½-in. centre lathe and a Binns & Berry JB lathe. A Jones & Shipman universal grinding machine is on order.

Denbigh Engineering Co., Ltd., Horseley Heath, Tipton, Staffordshire, are experiencing a steady call from merchants for their bench and pedestal drilling machines and D type horizontal milling machines. The latter, which supersedes the well-known C type, has a steplessly-variable drive to the spindle and powered table traversing movement. It may be arranged for air/hydraulic table operation, for production work, if required.

Russell Auto-feed Screwdrivers (Branch of Needle Industries, Ltd.), Studley, Redditch, Worcs., are extremely busy in meeting the demand

Special-purpose Russell Auto-Feed screwdriving machine for inserting six screws simultaneously into terminal blocks

for their range of screw- and pin-driving machines which are widely employed in this country and other parts of the world for inserting wood screws and metal screws, including grub screws, also a variety of headed pins, in terminal blocks, spectacle frames, and clock assemblies, for example. Standard machines are built for inserting one, two, or three screws or pins automatically, in one operation, and other machines, with hopper feeds and special purpose fixtures, can be supplied for special applications.

One of the latter, built for inserting six screws simultaneously in terminal blocks, is shown in the illustration on page 225. Screws, tipped into the hopper at the top of the machine, are directed, by the movement of a hinged plate, into grooves communicating with six vertical tubes, and thence to the multiple screwdriving head mounted above the work. The machine is controlled by a pedal, and provides for inserting screws at rates in excess of 200 per min.

Mention may also be made of special machines for the automatic insertion of screws, in pairs, into electric plugs; and of a more complicated machine, with hopper feeds and four work stations, for the assembly of clock components. On the latest standard machine which has added to the range, the spindle speed has been increased to 1,000 r.p.m. as compared with the previous speed of 600 r.p.m.

PNEULEC, LTD., Mafeking Road, Smethwick, Birmingham, 40—founded in 1921—specialize in design and construction of a wide variety of foundry equipment intended mainly for the production of ferrous castings in the medium and large size ranges. The scope of this company's activities covers a large field, including the provision of plant for the drying and conveying of sand, also equipment for the moulding and casting of metals and the production of cores by various methods. The research department is at present occupied with several interesting projects, one of which is concerned with the reclamation of core sand, and another with the development of hydraulically-operated squeeze-moulding equipment which will incorporate a self-contouring head designed to afford close control over the horizontal and vertical flow movements of the moulding sand.

F. W. HERRIDGE.

Halifax and District

HALIFAX TOOL CO., LTD., West Lane, Southowram, report that their works are maintaining a high rate of production of Halco-Stennick deep-hole rock drilling machines. Other activities of the company include the production of a wide range of tungsten-carbide components, from the raw materials stage. These products include a range of Halco standard lathe tools; cutters and tools for rock and coal boring; tools for the pottery trades; sand blasting nozzles; and components for use in the chemical and textile industries. We are informed that approximately 70 per cent of the total output of the works is exported to various countries.

A new heat treatment department, with an area of some 4,000 sq. ft., has recently been built and additions to the machine shop plant have included a Dean, Smith & Grace type 21 centre lathe and a Union horizontal boring machine.

DENHAM'S ENGINEERING CO., LTD., Holmfield, inform us that the works are at present concentrating on the production of the standard range of 17- to 42-in. swing centre lathes, and that the 17-, 22- and 25-in. swing machines have been in particularly good request in recent months. A steady flow of export orders for these lathes is being received, South Africa and New Zealand being prominent among overseas markets.

The type B.V. lathe, shown last year at Olympia, has been well received, and the range of sizes has recently been extended to include 29-, 32- and 37-in. swing capacities. All lathes of this type will be available shortly with hardened and ground steel bed-ways as an optional feature.

Machines recently despatched from the works have included three 25-in. swing lathes with hardened and ground steel bed-ways for David Brown Industries, Ltd., Heavy Gear Division; two similar machines, provided with profiling equipment, for the Chesterfield Tube Co., Ltd.; and two 28-in. swing lathes designed for turning Nimonic billets, one of which is arranged for facing operations at constant cutting speed; also a number of lathes for India.

BINNS & BERRY BROTHERS (HALIFAX), LTD., Ovenden, report an unparalleled demand for their standard 12½-in. centre lathe. Approximately 50 per cent of the orders now in hand are for export to various countries including Japan, Sweden, and the U.S.A. Work at present in progress includes a number of lathes with 25-ft. long beds which are destined for Japan.

We are informed that the thread whirling machines built by the company are being progressively developed, and that there is a steady call for these machines, mainly from the home market.

HALIFAX RACK & SCREWCUTTING CO., LTD., Ovenden, suppliers of precision cut machine racks

and traverse screws, report a heavy increase in the demand for their services, especially from the machine tool industry.

We are informed that output over the past twelve months has been increased by 100 per cent, and that a new rack cutting machine and a new thread whirling machine are shortly to be installed to help to keep pace with increasing production requirements.

WILLSON LATHES, LTD., Ovenden, report that their works are busy with the production of the Mk.5. centre lathe, which is available with bed lengths up to 18 ft., machines with beds up to 12 ft. long having hardened and ground ways; also the 6-in. Mk.1. centre lathe which has hardened and ground bed-ways and is built in two sizes of 2-ft. and 3-ft. length capacity between centres. In addition, a number of the 11-in. centre height lathes, with vee-guide beds, are being built with bed lengths ranging up to 20 ft., to meet a steady demand.

To permit more efficient production, a reorganization and re-equipment programme is at present being carried out in the works, and machine tools recently installed have included a Warner & Swasey type 2.A.C. automatic; a Samand tool grinder; and a 13-in. centre lathe with a 25-h.p. motor drive, of the company's own make. A Town radial drilling machine and a Lumsden surface grinder are due for early delivery.

R. SUTCLIFFE.

Bradford

MOORE MANUFACTURING CO., LTD., Blanche Street, report that during recent months there has been a continued increase in the demand for their range of engineers' small tools which includes lathe centres, milling cutters, drill sleeves and sockets, milling machine arbors and adapters, end mills, and reamers. We are informed that a good proportion of the current production is for export, and that, in particular, a large volume of orders for drill sleeves and sockets is being received from many countries overseas. Among machine tools and equipment recently installed in the works may be mentioned a Scrivener centreless grinder and two Parkson No. 2 universal milling machines.

CROFTS (ENGINEERS), LTD., Thornbury, are busy with their wide range of products, and demand for radiation gear units, couplings, V-belt drive units, and Ritespeed motorized conveyor pulley units is particularly heavy at present. The contract gear cutting department of the works and the ferrous and non-ferrous foundries are reported to be working to capacity.

A new stock holding branch was recently opened by the company at 21 Smith Street, Manchester, 16, to provide an improved service for the engineering industry in the North-West.

T. BOWERS & CO., LTD., Thornbury Street, inform us that their factory is at present working to full capacity on the range of small tools, also on jigs, fixtures, gauges, and special tooling, which are made on a contract basis. The company's new internal micrometer has been well received in both the home and export markets, and a number of the orders in hand for this instrument are from Sweden, France and Norway. New plant recently installed in the works includes a Jones-Shipman universal grinding machine and three toolroom lathes.

STANHOPE ENGINEERS, LTD., 92 Harris Street, report that they have a large volume of orders from both home and overseas customers for their range of rotary gear pumps, including an important contract from Italy covering units of various sizes. Fuel oil transfer pumps are in steady demand, and it was noted that a large amount of contract machining work is at present being undertaken.

HINDLE AUTO PRODUCTS, LTD., Caledonia Street, inform us that they are experiencing an unparalleled demand for precision gears, spline shafts, and gearbox units. Work at present in progress includes a number of ground splined shafts for use in the nuclear energy field and we are informed that the tolerances specified for these shafts are only 25 per cent of the British Standard values. Mention may also be made of a 5½-in. diameter component with 21 involute splines for which a single cutter and an indexing fixture are employed. This part must be produced with a pitch accuracy of 0·001 in.

Equipment recently installed in the works includes a Milnes heavy-duty fine boring machine with Hilger & Watts optical measuring equipment; a Churchill Redman P.5 automatic copying lathe; and a Birfield-Somua hydraulic spline milling machine.

STERLING MANUFACTURING CO., LTD., Lower Cobden Street, inform us that although the works are making independent and self-centring lathe chucks on a limited scale, the greater part of the production capacity is devoted to the machining of a wide range of components on a contract basis, for companies engaged in various branches of engineering. It was noted that whereas most sections of the works are fully occupied, a small amount of milling capacity is at present available.

ELLIOTT & MUSGRAVE, LTD., Longside Lane, makers of patterns in wood, metal and plastics, in-

form us that they are experiencing an increasing call for their services from the machine tool, motor car, and other engineering industries. The company also supplies textile conveyors to a number of machinery builders, and we are informed that this section has been very busy during recent months.

HENRY MILNES, LTD., Ingleby Works, Rosse Street, report a steady call for their standard milling machines and centre lathes and a growing demand for their range of heavy-duty fine boring machines. We are informed that orders have been received for a number of double-ended machines in the past few weeks and that the standard types are now available with Micro-bore tooling, Hilger & Watts optical measuring equipment, and Ferranti co-ordinate positioning equipment.

It was noted that the company has recently developed a push-button operated automatic draw bar for incorporation in the spindles of fine boring machines, which is at present undergoing tests in a customer's works. We hope to publish full details of this equipment in a future issue.

N. JOWETT & CO., LTD., Littlemoor Works, Queensbury, report that they are busy with the production of their thread milling and gear hobbing machines. A number of these machines was recently exported to Australia, and numerous enquiries have been received from India and the South American countries. Recent additions to the machine tools installed in the works include a Churchill cylindrical grinder.

R. SUTCLIFFE.

Personal

MR. R. A. NICHOLSON, steel sales manager of Sanderson Brothers & Newbould, Ltd., Attercliffe Steelworks, P.O. Box No. 6, Newhall Road, Sheffield, 9, recently retired after 51 years of unbroken service with the company. He was formerly production manager of the steel department.

MR. D. F. CAMPBELL, chairman of Davy-Ashmore, Ltd., Darnall Works, Sheffield, 9, has announced his intention to retire from the board at the conclusion of the forthcoming annual general meeting in September. The directors of the company have designated Mr. M. A. Fiennes to succeed him, and Mr. L. H. Downs will become vice-chairman.

MR. D. J. AMERY and MR. J. E. CONNOR, who are production engineers at the Telephone Works of The General Electric Co., Ltd., in Coventry, have been awarded Sir Alfred Herbert Travelling Scholarships for 1961. These awards are made annually by the Machine Tool Trades Association in commemoration of the 90th birthday of the late Sir Alfred Herbert.

MR. STAFFORD BEER, who has been head of the department of operational research and cybernetics of The United Steel Companies, Ltd., The Mount, Broomhill, Sheffield, 10, since its inception in 1957, has resigned to become managing director of a new international firm of operational research consultants based in London. MR. DAVID OWEN, previously assistant head of the department, will succeed Mr. Beer from August 1.

The following new appointments have been announced:—

SIR BEN LOCKSPEISER, MR. C. F. HODSON, and MR. W. H. WEST as directors of J. H. Shand, Ltd., Anchor Hill, Axminster, a member company of the Staveley Group.

MR. JOHN T. MCCARLEY, director of manufacturing-international, as managing director of the British Division of The Yale & Towne Manufacturing Co., Willenhall, Staffs.

MR. ROBERT W. SUGDEN as sales representative for Landis Lund, Ltd., Cross Hills, Keighley, in Yorkshire and the North Midlands. He was formerly sales representative for the company in Ireland and the North Eastern counties.

MR. JOHN A. KNOWLES as a member of the sales staff at the Bristol office of Brook Motors, Ltd., Huddersfield. A former Brook apprentice, he has been with the company for 12 years.

MR. B. D. BLACKWELL, deputy chief engineer, Aero Research and Development, to succeed Brigadier J. Innes (a special director) as business manager, Aero, for Bristol Siddeley Engines, Ltd., Patchway Works, P.O. Box 3, Filton, Bristol.

MR. J. D. WRIGHT as manager of the Templeborough melting shop of the Steel, Peech & Tozer branch of The United Steel Companies, Ltd., The Mount, Broomhill, Sheffield, 10, in succession to Mr. H. H. England, who has resigned.

MR. PERCY ALLAWAY as managing director of E.M.I. Electronics, Ltd., Hayes, Middlesex, in succession to Mr. Clifford Metcalfe, C.B.E., who has relinquished the post at his own request. Mr. Metcalfe remains a full-time director of Electrical & Musical Industries, Ltd.

MR. M. H. GARDINER, F.C.A., and MR. C. PHILLIPS, M.I.Mech.E., M.I.Prod.E., as joint managing directors of Redman Tools & Products, Ltd., Gregory's Bank, Worcester. MR. A. M. REDMAN continues to hold the office of chairman.

MR. E. MASON, as general manager of the factory o Rank Precision Industries, Ltd., Cine and Photographic Division, Mitcheldean, Gloucestershire, makers of Bell & Howell 8-mm. and 16-mm. cinematographic equipment and allied products. He was previously works manager of Brush Electrical Engineering Co., Ltd., Loughborough.

MR. CHAS E. ROGERSON, O.B.E., F.C.A., as vice-chairman, and MR. V. M. MARSHALL, M.I.Loco.E., as a director of Edward G. Herbert, Ltd., Atlas Works, Levenshulme, Manchester, 19. MR. ALAN KIERNAN, M.I.Mech.E., and MR. SAM SMILEY, F.C.C.S., A.A.C.C.A., who were directors, have retired from the service of the company.

MR. TIMOTHY H. KINDERSLEY, M.A., A.M.I.C.E., as chief engineer of the Engineering Products Division of

Allis-Chalmers Great Britain, Ltd. He will be at the London office in Salisbury House, London Wall, E.C.2. The position has been newly created in connection with the company's programme of expansion.

Progress of New Ferodo Factory

On July 17, Mr. Ronald Soothill, chairman of Turner & Newall, Ltd., laid the foundation stone of the new factory which is being built for Ferodo, Ltd., Chapel-en-le-Frith, Stockport (a member company of the Turner & Newall Group), at Griffiths Crossing, Caernarvon, at a cost of £2½ million. Excavation work began in January, and the steel framed building is already almost fully cladded. It is estimated that the project will be completed by April, 1962. The factory, which is being built by Taylor Woodrow Construction, Ltd., will produce textile brake linings and clutch facings and Ferodo non-slip stair-treads. The main production block will have an area of 240,000 sq. ft.

Work will be provided initially for 500 people, and the number may later rise to 1,000.

U.S. Machine Tool Exports

The following table gives the quantities and value of exports of various classes of machine tools from U.S.A. during February, 1961:—

	Number	Value $
Light-duty and bench lathes	41	49,907
Engine lathes	65	360,985
Turret lathes	19	343,777
Automatic chucking and between-centre lathes	30	1,473,928
Automatic screw machines	13	601,739
Other lathes	16	325,990
Vertical boring and turning mills, and vertical turret lathes	5	63,176
Fine boring machines	2	22,560
Jig boring machines	6	358,653
Tapping and threading machines	153	195,377
Milling machines	73	470,315
Profiling, duplicating and diesinking machines (milling type)	17	269,535
Gear cutting machines	80	1,823,537
Gear grinding and finishing machines	33	458,246
Drilling machines	187	620,767
Planing, shaping and slotting machines	15	264,317
Surface grinding machines	66	716,557
Tool and cutter grinding machines	63	354,956
Other grinding machines	413	2,974,052
Sawing and cutting-off machines	69	188,460
Honing and lapping machines	33	251,779
Multi-station machine tools	2	471,403
Broaching machines	1	64,907
Hydraulic presses	59	634,179
Mechanical presses	106	1,278,228
Bending and roll forming machines	102	604,582
Punching and shearing machines	51	292,798
Forging machines and hammers	43	676,296
Other machines	185	597,318

Industrial Notes

INSTRUMENTS & MOVEMENTS, LTD.—From August 8, the address of this company will be Half Moon Hill, London Road, Dunstable, Beds. The telephone number (Dunstable 64414-5) will not be changed.

CRANES (DEREHAM), LTD., Dereham, and CRANE FRUEHAUF TRAILERS, LTD., North Walsham, inform us that the address of their London office is now 8 York Buildings, Adelphi, W.C.2 (telephone, Trafalgar 1781).

TESTING MACHINES INC., 72 Jericho Turnpike, Mincola, Long Island, N.Y., U.S.A., have issued a list covering 1,239 physical testing machines, compiled from world wide sources. The various items are arranged alphabetically. Copies of the list are obtainable from the above address.

ADREMA, LTD., Telford Way, East Acton, London, W.3, recently announced that staff conditions would in future apply to all the hourly-paid workers in their six factories. Clocking-in has thus been abolished, and all workers will have three weeks' holiday with pay, and will participate in the staff pension scheme. Instead of clocking-in, employees will sign in a book.

BRITISH INDUSTRIAL ENGINEERING CO., LTD., Tividale, Staffs., report continued expansion of business, especially in overseas markets. During the first six months of this year, the value of exports of pipe supports and structural steelwork increased by 50 per cent. To meet the expanding demands, additional factories have been opened at Old Hill, Staffs., and Droitwich, Worcs.

ASSOCIATED ELECTRICAL INDUSTRIES, LTD., Crown House, Aldwych, London, W.C.2, have entered into an agreement with Facit Electronics AB of Sweden, whereby the Electronic Apparatus Division have been appointed sole agents in the United Kingdom and British Commonwealth (except Canada) for the Facit Carousel random access magnetic tape memory machine, high-speed tape punch, and high-speed reader.

THE INDUSTRIAL WELFARE SOCIETY, Robert Hyde, House, 48 Bryanston Square, London, W.1, have issued a booklet by Dr. Patricia Shaw entitled "Enjoying Retirement." It is intended to benefit those who will be retiring on pension in four or five years' time, and to help them "to prepare now to transform those potentially empty years into years of useful leisure." Copies are obtainable from the above address, price 2s. 6d. each, plus 6d. postage.

PYE-LING, LTD., is the title of a new company which has been formed by Pye, Ltd., Cambridge, and Ling Temco Electronics, Inc., Dallas, Texas, U.S.A. This company replaces the Vibration Division of the Pye subsidiary W. Bryan Savage, Ltd., and the products will include the Savage range of vibration testing equipment and the Ling range. It is pointed out that these ranges are largely complementary.

HANCOCK & CO. (ENGINEERS), LTD., Croydon, Surrey, recently despatched a special oxygen cutting machine for plate splitting to the South African Iron and Steel Industrial Corporation, near Johannesburg. This machine the cost of which exceeds £5,000, has a capacity for plates from ⅜ to 9 in. thick, and the cutting area is 80 ft. by 12 ft. It is of the gantry type and is fitted with 12 individual floating vertical burners. To meet customers' requirements, provision has been made for cutting 45-deg. bevels.

GENERAL TRADE EQUIPMENT, LTD., 82-90 Seymour Place, London, W.1, are now marketing an eye magnet probe with magnifier. Of stainless steel, the instrument has a fluted barrel along which a magnifying glass can be adjusted. There is a cap at each end of the barrel, one containing a magnet for the removal of iron and steel particles, and the other a looped piece of cat-gut for non-magnetic matter. The magnifying glass is focussed on the object in the eye.

THE UNITED STEEL COMPANIES, LTD., The Mount, Broomhill, Sheffield, 10, have purchased Barrow Steel Works, Ltd., from the Iron and Steel Holding and Realisation Agency for the sum of £2,200,000. United Steel have managed the works since 1943, and in 1952 a pilot continuous casting plant was installed for the purpose of producing billets for re-rolling from local scrap supplies. The process, it is stated, is now being operated successfully, and two full-scale, twin-strand, continuous casting machines and a 20-ton electric arc furnace are being installed.

FIELDING & PLATT, LTD., Gloucester, have received an order from Henry Wiggin & Co., Ltd., Hereford, for a 3,500-ton Fielding horizontal hydraulic press for the extrusion of Nimonic alloys. The total value of the contract, which also covers auxiliaries, is of the order of £250,000. Provision will be made for the use of a piercing mandrel to enable both solid and hollow sections to be produced, and a number of novel features will be included to permit close control of the extrusion process and to enable idle time to be reduced. The press will be direct pumped, and the total installed brake horse power will be approximately 4,000.

TRANSPORT COSTS FOR INDUSTRY IN NORTHERN IRELAND. The results of an inquiry into transport costs as a factor affecting the development of industry in Northern Ireland were recently announced by the Northern Ireland Development Council. The inquiry covered 15 different types of industry and showed that, with one exception, the transport of finished products from Northern Ireland did not exceed 2·8 per cent of the sales value, and in ten industries was less than 1·5 per cent. Costs of inward transport of raw materials did not exceed 2 per cent of subsequent sales value, and in nine industries were less than 1 per cent. For light engineering, inward transport costs of raw materials were 1·9 per cent, and outward costs 0·6 per cent of sales value.

WILD-BARFIELD ELECTRIC FURNACES, LTD., Elecfurn Works, Otterspool Way, Watford By-Pass, Watford, Herts., inform us that they have recently received exports orders from ten different countries, and that overseas business now accounts for some 30 per cent of their sales. These orders

embrace, for example, vacuum induction and resistance heated furnaces for Sweden and the International Atomic Energy Agency in Austria; a vertical pit type gas carburising furnace for Sweden; a large mesh belt conveyor type and an ACE sealed quench furnace for Holland; a pit type vacuum furnace of the internal element type and an electron beam welding unit for Belgium; and a mains frequency induction-heated aluminium holding furnace for Japan.

NAPIER AERO ENGINES, LTD. The English Electric Co., Ltd., and Rolls-Royce, Ltd., have agreed in principle on arrangements whereby the aero engine business of D. Napier & Son, Ltd. (a subsidiary of English Electric) will in future be carried on by a new company with the above title, which will be owned equally by D. Napier & Son, Ltd., and Rolls-Royce, Ltd. It is intended that Mr. J. D. Pearson, deputy chairman and chief executive of Rolls-Royce, Ltd., shall become chairman of Napier Aero Engines, Ltd. The London factories of D. Napier & Son, which are principally engaged in aero engine work will be operated by the new company. D. Napier & Son, Ltd., will continue their other engineering business, and activities in the factories and establishments at Luton, Liverpool, and Netherton will not be affected.

Films on Human Relations in Industry

Typical situations that involve misunderstandings between factory employees and their supervisors are examined in six new 16-mm. sound films which have been added to the G.B. Film Library, 1 Aintree Road, Perivale, Greenford, Middlesex.

Designed for showing to industrial supervisory staff, these 8-minute films are based on actual instances which were reported by the Aluminium Company of America, and are intended to provide a basis for discussions on how the situations described might have been avoided.

The titles of the films are: "The Hidden Grievance," "Enforcing Rules and Procedures," "Personality Conflict," "Delegating Work," "The Trouble with Women," and "The Personal Problem."

New Astley Group Headquarters

Astley House, 33 Notting Hill Gate, W.10, the new London headquarters of the Astley Group of finance companies, was recently opened officially by Lord Rootes, who was introduced by the chairman, Colonel Sir Stanley Bell. Companies in the Astley Group, which is a member of the Finance Houses Association, include Astley Industrial Trust, Ltd., and the Astley Leasing Co., Ltd., and these two organizations provide, respectively, facilities for the hire purchase and leasing of industrial plant and equipment in all parts of the country. In his speech, Sir Stanley said that the leasing of industrial plant, which was already popular in America, offered advantages to both small and large firms, and it was intended to extend leasing facilities in the light of experience.

It is stated that a one-third interest in the Group is held by the District Bank, Ltd., and that the Pearl Assurance Co., Ltd., also has a substantial interest.

Scrap Metals

MIDLANDS.—The difficulties at present experienced in disposing of practically all grades of scrap are not likely to be lessened until well after the Midlands industrial holiday period has ended. Merchants are committed under contract to collect from local works and consequently such scrap is being stocked in preference to odd parcels which are on offer from casual suppliers.

One local steelworks has suspended deliveries of all grades until further notice and others are only accepting deliveries of No. 1 grade material under allocation until July 28.

Chipped and bushy steel turnings are being moved steadily, but larger tonnages are available than can be placed each week. For borings there appears to be a ready sale but during the next few weeks difficulties may arise in connection with the disposal of rail loaded material as consumers will not allow wagons to wait under demurrage.

Short heavy steel scrap is difficult to place, and prices are falling to nearer basic heavy steel levels for the poorer class of short material.

The cast iron market is very lively and restrictions will only be brought about by holiday closing. Broken cylinder iron is in keen demand in this area and prices have improved for complete loads of this type of iron.

Outlets for destructor bales are hard to find, and, together with other bundles, they are necessarily being stocked until after the holidays.

Oversize scrap for shearing and cutting by gas is acceptable at merchants' yards, but as immediate disposal of the processed scrap is out of the question at present there is a tendency for prices to ease by as much as 20s. per ton.

Progress in Precision

(*Continued from page* 179)

on two torsion bars by spiral springs can be varied by turning a frame to which the opposite ends of the springs are anchored, and it is stated that an angular movement as small as 0·02 sec. can be applied in this way. Finally, mention may be made of a requirement that a mirror on a slide must be parallel to a common plane within 0·05 sec., when the slide is in various positions. Because the degree of straightness of the guiding surfaces necessary to ensure this condition could not be achieved, provision is made for elastically deforming a support at one end of the bed to restore parallelism at any position.

It will thus be evident that the design and construction of this equipment has represented an important contribution, both directly and indirectly, towards greater precision. Not only will it enable line and end standards to be calibrated more accurately, but certain features will no doubt find application in other connections to enable the potentialities of these standards to be more effectively exploited.

Machine Tool Share Market

After being dull and unsettled, with a generally lower trend for the most part, stock markets rallied, and the period under review ended on a fairly steady note.

The gilt-edged section, after displaying some weakness, became moderately active, and on balance there were fractional improvements among British Funds and similar fixed interest stocks.

Depressed conditions prevailed in the commercial and industrial sections and prices suffered some sharp setbacks. Near the close, however, the tone strengthened following a mild revival of buying activity, and many gains were recorded.

Among machine tool issues, Abwood Machine Tool lost 6d. at 1s. 9d; Edgar Allen, 6d. at 36s. 6d.; Asquith Machine Tool, 1s. at 9s.; Birmingham Small Arms, 1s. 6d. at 22s. 6d.; British Oxygen, 6d. at 21s. 6d.; Broom & Wade, 1s. 9d. at 22s. 6d.; Chas. Churchill, 4½d. at 8s. 6d.; Clarkson (Engineers), 2s. at 38s.; Geo. Cohen, 6d. at 11s. 3d.; Coventry Gauge & Tool, 2s. 3d. at 27s.; Craven Bros. (Manchester), 6d. at 8s.; B. Elliott, 3d. at 2s. 6d.; John Harper, 4½d. at 8s.; Alfred Herbert, 2s. 6d. at 62s. 6d.; A. A. Jones & Shipman, 1s. 3d. at 22s. 6d.; H. W. Kearns, 1s. 6d. at 22s. 6d.; Kerry's (Gt. Britain), 6d. at 9s. 6d.; Samuel Osborn, 1s. at 48s.; Ambrose Shardlow, 3s. 4½d. at 58s. 1½d.; John Shaw & Sons (Wolverhampton), 7½d. at 17s.; Tap & Die Corporation, 9d. at 15s. 6d.; and Thos. W. Ward, 7s. 6d. at 67s. 6d.

*New Companies Registered**

CRADLEY TOOL & GAUGE, LTD., 9 Station Road, Cradley Heath, Staffs. Registered July 11, 1961. Nom. cap.: £10,000 in £1 shares. Directors: G. Allsopp, D. R. Chater, B. Millward, and R. S. Wall.

STOREY METAL INDUSTRIES, LTD., Lingard Lane, Bredbury, Cheshire. Registered July 10, 1961. Nom. cap.: £250,000 in 5s. shares. Directors: T. Storey, and Mrs. M. E. Storey.

SAVAIR PRODUCTS, LTD., Stafford House, Norfolk Street, Strand, London, W.C.2.—Registered June 23, 1961. To carry on the business of engineers, founders, smiths, machinists, manufacturers and patentees of resistance welding equipment, pneumatic and hydraulic equipment, etc. Nom. cap.: £10,000 in £1 shares. Directors: A. F. A. Powles and C. G. Tanner.

* From the lists compiled by Jordan & Sons, Ltd., Company Registration Agents, 116-118 Chancery Lane, London, W.C.2.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd	Ord.	1/-	1/9
Allen (Edgar) & Co., Ltd	Ord.	£1	36/6
" "	5% Prf.	£1	13/6*
Arnott & Harrison, Ltd	Ord.	4/-	9/- ex captn.
Asquith Machine Tool Corp., Ltd	Ord.	5/-	9/-
" " "	6% Cum. Prf.	£1	16/6
Birmingham Small Arms Co., Ltd	Ord.	10/-	22/6
" " "	5% Cum. "A" Prf.	£1	14/6
" " "	6% Cum. "B" Prf.	£1	17/-
" " "	4% 1st Mort. Deb.	Stk.	90½
British Oxygen Co., Ltd	Ord.	5/-	21/6xd
" " "	6% Cum. Prf.	£1	19/-
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	9/10½
Broom & Wade, Ltd	Ord.	5/-	22/6
" "	6% Cum. Prf.	£1	16/6
Brown (David) Corporation, Ltd	5½% Cum. Prf.	£1	15/-
Buck & Hickman, Ltd	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd	Ord.	5/-	16/3
" " "	5% Cum. Prf.	£1	14/3
Churchill (Charles) & Co., Ltd	Ord.	2/-	8/6
" " "	6% Cum. Prf.	£1	25/7½‡
Clarkson (Engrs.), Ltd	Ord.	5/-	38/-
Cohen (George), 600 Group, Ltd	Ord.	5/-	11/3
" " "	4½% Cum. Prf.	£1	11/6
Coventry Gauge & Tool Co., Ltd	Ord.	10/-	27/-
" " "	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd	Ord.	5/-	8/-
Elliott (B.) & Co., Ltd	Ord.	1/-	2/6
" "	4½% Red. Cum. Prf.	£1	12/-
Firth Brown Tools, Ltd	4% Cum. Prf.	£1	10/6
Greenwood & Batley, Ltd	Ord.	10/-	20/1½xd
Harper (John) & Co., Ltd	Ord.	5/-	8/-
" " "	4½% Red. Cum. Prf.	£1	11/7½
Herbert (Alfred), Ltd	Ord.	£1	62/6
Holroyd (John) & Co., Ltd	"A" Ord.	5/-	17/6
" "	"B" Ord.	5/-	17/6
Jones (A. A.) & Shipman, Ltd	Ord.	5/-	22/6
" " "	7% Cum. Prf.	5/-	4/9
Kearney & Trecker-C.V.A., Ltd	5½% Red. Cum. Prf.	£1	11/-
" " "	Prefd. Ord.	£1	13/9
Kearns (H. W.) & Co., Ltd	Ord.	5/-	22/6
Kerry's (Gt. Britain), Ltd	Ord.	5/-	9/6
Macreadys Metal Co., Ltd	Ord.	5/-	16/6
Martin Bros. (Machinery), Ltd	Ord.	2/-	2/6
Massey (B. & S.), Ltd	Ord.	5/-	11/-
Newall Engineering Co., Ltd	Ord.	2/-	8/-
Newman Industries, Ltd	Ord.	2/-	7/-
" "	6% Prf. Ord.	5/-	5/-xd
Noble & Lund, Ltd	Ord.	2/-	6/-
Norton, W. E. (Holdings), Ltd	Ord.	2/-	8/6
Osborn (Samuel) & Co., Ltd	Ord.	5/-	48/-
" " "	5½% Cum. Prf.	£1	23/-
Pratt (F.) & Co., Ltd	Ord.	5/-	18/3
Sanderson Kayser, Ltd.	Ord.	10/-	32/6
" "	6½% Cum. Prf.	£1	16/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	9/-
Shardlow (Ambrose) & Co., Ltd	Ord.	£1	58/1½
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	17/-
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	19/3
" " " "	5% Cum. Prf.	£1	13/3
Stedall & Co., Ltd	Ord.	5/-	7/9
Sykes (W. E.), Ltd	"B" non-voting Ord.	10/-	28/9
Tap & Die Corporation, Ltd	Ord.	5/-	15/6
" " "	4½% Deb. 1961-1977	Stk.	82½
Wadkin, Ltd	Ord.	10/-	26/-
Ward (Thos. W.), Ltd	Ord.	£1	67/6
" "	5% Cum. 1st Pref.	£1	13/6
" "	5% Cum. 2nd Pref.	£1	21/6
Willson Lathes, Ltd	Ord.	1/-	3/-

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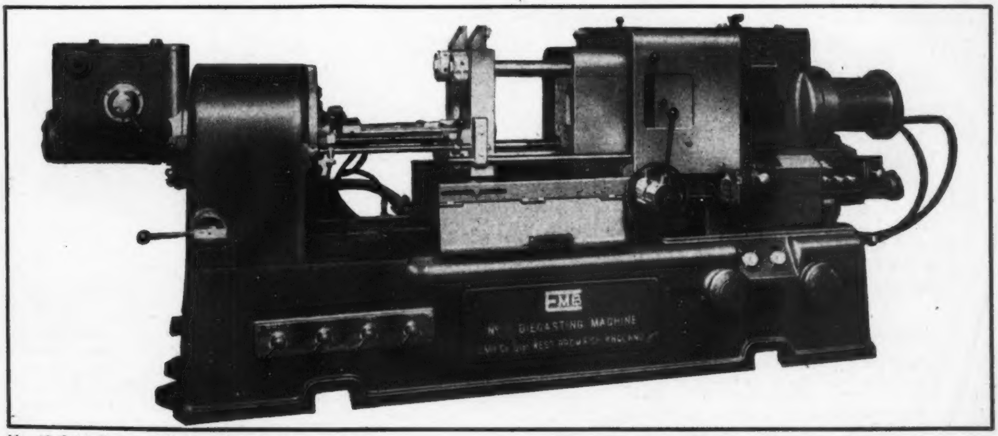

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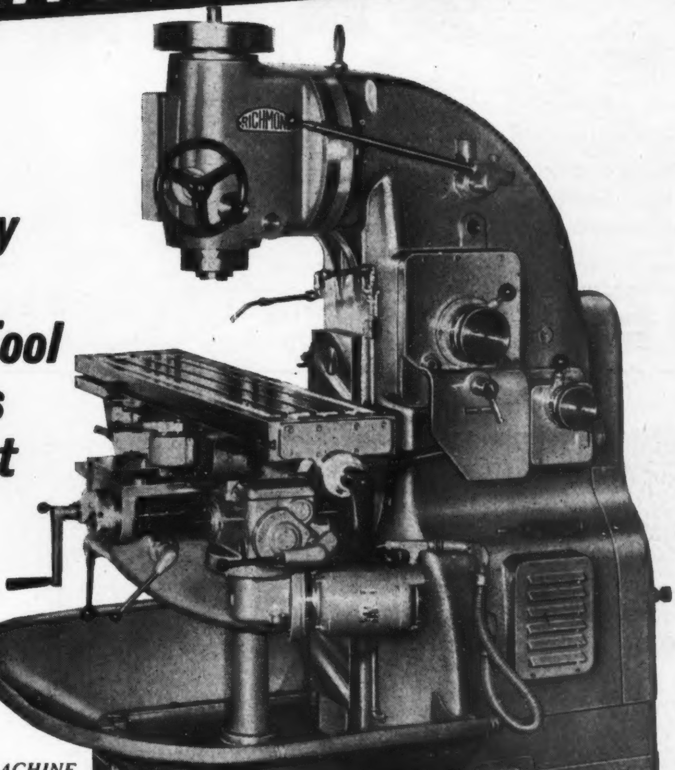

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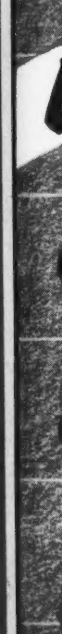

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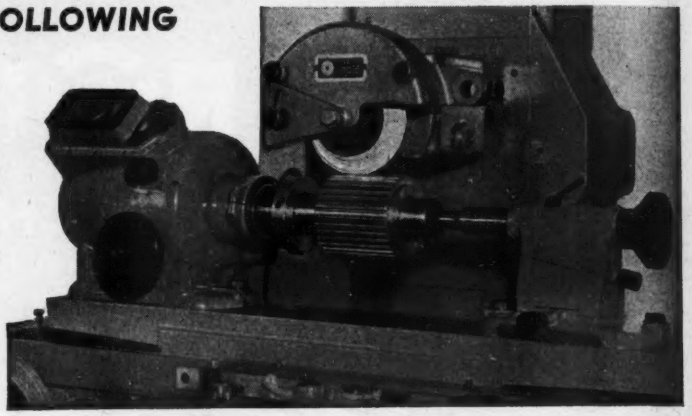

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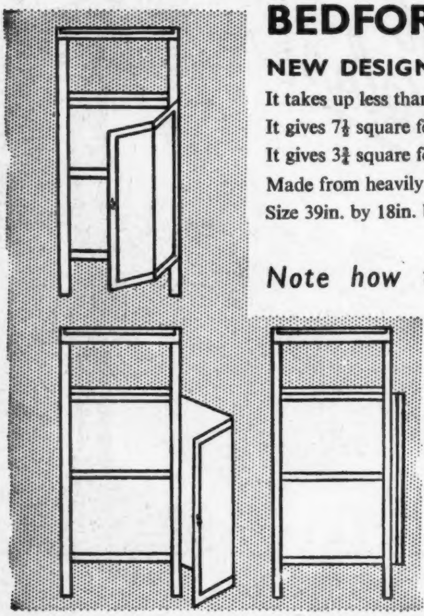

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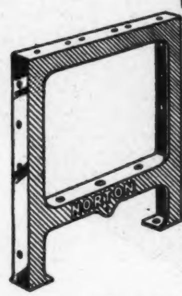

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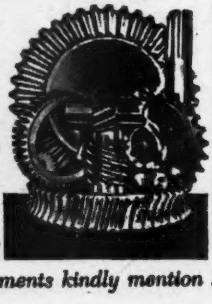

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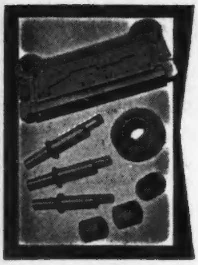

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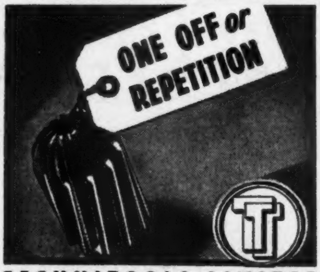

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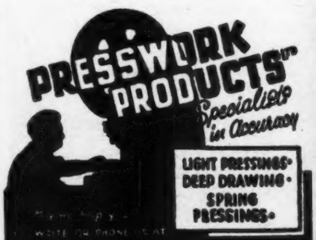

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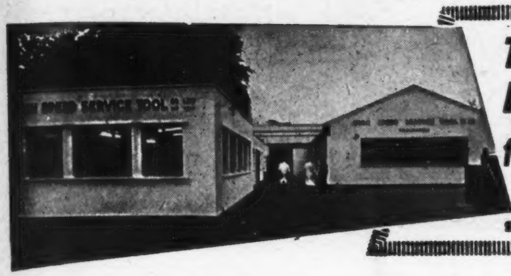

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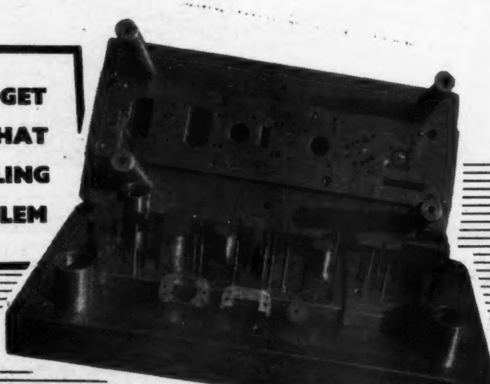

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SCULFORT FOCKEDY 12in. Centres High Speed Gap Bed S.S. & S.C. Lathe, 14ft. between centres.

OLDFIELD & SCHOFIELD 32in. Swing Gap Bed S.S. & S.C. Lathe, 10ft. between centres, swing in gap 50in. × 16in. Taper turning attachment.

MITCHELL 8½in. Centres Gap Bed S.S. & S.C. Lathe. Several available. All As New. 52in., 54in. and 64in. between centres.

WARD No. 13 Combination Turret Lathe, covered bed, 25in. concentric chuck, 27in. 4-jaw independent chuck. Good turret tooling, taper turning attachment, 35 h.p. motor, 400/3/50. Modern machine. Excellent equipment.

KENDALL & GENT 6ft. × 4ft. × 4ft. 6in Plano Milling Machine. With vertical head 27 spindle speeds 12 to 700 r.p.m., 9 feeds to table.

CINCINNATI Hydromatic 56-72 Hydraulic Plain Horizontal Production Milling Machine. Table 103in. × 26in., speeds 24 to 179 r.p.m.

CINCINNATI Model 4HP Heavy Duty Vertical Milling Machine. Table 72in. × 19in., speeds 17 to 480 r.p.m.

ORMEROD 20in. Stroke Pedestal Type Shaping Machine. 9 speeds 9 to 104 s.p.m., 5 h.p. motor. Two machines available.

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Telephone: RODney 7822.
Telegrams: Acfirb London S.E.17.

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RYDERMATIC No. 12 Vertical Multi-Tool Lathe.

BROACH

FORST RIA5 Universal Vertical Broach for internal and surface broaching, 5 tons, 39⅜in. stroke. 1952 machine.

GRINDERS

BROWN & SHARPE No. 2 Surface.
New ALPA Surface, 32 × 8in.
JUNG AS Internal.
KEIGHLEY Type XL Hydraulic Plain Grinder, 6in. × 18in.
CHURCHILL 10in. × 24in. Universal.
LANDIS 12 × 48 Universal.
BROWN & SHARPE No. 3 Universal.
NORTON 14in. × 36in. Universal.
New BAMKIN Tool and Cutter.

CAPSTAN AND TURRET LATHES

LEICHTI PR Turret Lathe (Swiss).
GISHOLT IL Turret Lathes.
FOSTER No. 2B Turret Lathe.

CENTRE LATHES

SMART & BROWN Type M 4in. Precision.
HENDEY 6in. × 30in. Taper Turning.
MONDIALE 7in. × 60in. Gap Bed.
CROMWELL 3½in. Precision.

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ARCHDALE 14in. Manufacturing type.
CINCINNATI Type OK 18in. Horiz.
EDGWICK 18in. Horizontal.
ARCHDALE 20in. Twin Overarm Horizontal. Table 40in. × 10in.
KENT-OWENS 1-8 and 1-14 Hydraulic Production.
New TAYLOR Vertical, table 17¾in. × 5½in.
HERBERT 23V Vert. Table 68in. × 17in. 48in. traverse.
REED PRENTICE No. 6 Veritcal. Table 84in. × 20in.
HELLER Automatic Thread Millers (4).
ASQUITH HKO Duplex Keyseater.

PRESS

V. & O. No. 11 Double Action. Approx. 10 tons. Roll feed. Max. draw 1in.

All machines motorised 400/3/50 unless otherwise stated.

MILLING MACHINES

CINCINNATI No. 3 Vertical, 53in. × 15in. Dial Type. Price on application.
BIERNATZKI Vertical H.4, 73in. × 18in. £350.
DENBIGH Horizontal, 40in. × 10in. £90.
HERBERT No. 8 Vertical. £675.
BROWN & SHARPE 2YB, 34in. × 11in. £185.

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New **KITCHEN WALKER** 6ft. E. 3 Radial Drilling Machine, No. 5 M.T. spindle.
ASQUITH LDR 4ft. 6in. Radial Drilling Machine, No. 4 MT spindle.
KITCHEN & WADE 6ft. Girder Type Radial Drilling Machine, 18 spindle speeds, 6 feeds, No. 5 M.T. spindle, motorised 400/3/50 supply.

BORING MACHINES

WEBSTER & BENNETT Series D 36in. Single Column Type Vertical Boring Mill, motorised 400/3/50 supply.

SLOTTING MACHINES

ORMEROD 12in. stroke Slotting Machine, 27in. dia. rotary table, motorised 400/3/50 supply.

LATHES

COLCHESTER 8½in. Mascot S.S. & S.C. Gap Bed Lathes, to admit 6ft. 6in. between centres.
WILLSON 7½in. S.S. & S.C. Lathe, to admit 3ft. between centres.
CRAVEN 15in. S.S. & S.C. Lathe, to admit 10ft. between centres.
DEAN, SMITH & GRACE Surfacing and Boring Lathe, with hexagon turret, swing over bed 24in., swing in gap 36in.
LANG 12½in. Gap Bed S.S. & S.C. Lathe, to admit 10ft. 6in. between centres.
CRAVEN 15in. S.S. & S.C. Lathe, to admit 25ft. between centres. Two Saddles.
LANG 15in. Centre Lathe, two saddles, admit 17ft. 6in. between centres, motorised 400/3/50 supply.

MILLING MACHINES

C.V.A. "Kearnley & Trecker" model 2E Dia Type Horizontal Plain Milling Machine, working surface of table 41in. × 12in., longitudinal feed 29in., cross feed 12in., 8 spindle speeds 25/1,000 r.p.m., motorised 400/3/50 supply.
CINCINNATI Model 3/36 Hydromatic Milling Machine, table 54in. × 14in., motorised 400/3/50 cycles.

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CINCINNATI 10 ton Vert. Single Ram Hydraulic Surface Broaching Machine, 66in. stroke, 20in. × 20in. table, motorised 400/3/50 cycles.

GRINDING MACHINES

JONES & SHIPMAN 8in. × 16in. Tool and Cutter Grinding Machine.
CHURCHILL 16in. × 36in. Model PBH Universal Grinding Machine, with hydraulic feed and internal grinding attachment.
JONES & SHIPMAN 10in. × 27in. Horizontal Spindle Hydraulic Surface Grinder.

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STIRK 10ft. × 4ft. 6in. × 4ft. 6in. "Hiloplow" Double Column Planing Machine, with four toolboxes, Stirk Split Field Motor Drive.

POWER PRESSES

One New **PEARSON** 75 ton Hydraulic Press Brake, 9ft. × ¼in. capacity, motorised 400/3/50 cycles.
New **BUTTERLEY** No. 4, 20 Ton Ungeared Power Press, 1in.-3in. adjustable stroke.

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NOBLE & LUND 24in./28in. Cold Circular Sawing Machine, 10in. dia. rounds, 9in. squares, 18in. × 7in. seams, motorised 400/3/50 cycles.

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KENDALL & GENT 3-2 Tangential Head Screwing Machine, to screw bolts up to 2in. outside diameter, tubes up to 3in. inside diameter, machine fitted with leadscrew motorised 400/3/50 supply.

MISCELLANEOUS

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All the above machines are motorised 400-440/3/50 cycles.

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TWO WARD 2A Capstan Lathes. Both equipped ball chuck and bar feed.

TWO WARD 3A Capstan Lathes. Both equipped ball chuck and bar feed.

DRUMMOND Model K Capstan Lathe, arranged for chucking. 2 1/16in. Hollow spindle.

HERBERT No. 7 Junior Combination Turret Lathe. Flamard bed.

ONE HERBERT 2B Capstan Lathe, arranged for chucking.

HERBERT 1S Capstan Lathe, part bar feed.

TWO MOREY 2G Capstan Lathes, arranged for chucking.

INDEX No. 36 Single Spindle Automatic.

HERBERT 1¼in. Single Spindle Bar Automatic, with equipment.

DEAN, SMITH & GRACE, A.N. Type, 7in. by 4ft. between centres S.S. & S.C. Gap Bed Lathe. 2in. H.S. Swing in gap 24¼in. by 7⅛in.

CARSTENS 4½in. by 20in. between centres S.S. & S.C. High Speed Precision Lathe, fully equipped with collets, chucks, etc.

CHURCHILL-CUB 5in. by 20in. between centres S.S. & S.C. Lathe, with chucks, pick-off gears.

KEARNS No. 2 Horizontal Boring and Facing Machine, with Vernier Height Gauge and Boring Bars.

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KITCHEN & WADE Heavy Duty Pillar Drill. Spindle bored No. 4 M.T. Rise and fall table 24in. dia., swings round column.

ARCHDALE Two-Spindle Relieving Drill, No. 1 M.T. Power feed and independent motor drive to each spindle. Table W.S. 36in. by 15in.

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DAVID BROWN Worm Shaft Milling Machine, 4in. centres by 33in. between centres.

BROWN & SHARPE No. 2 Universal Milling Machine. Table W.S. 46in. by 10in. Spindle speeds 30-1,300 r.p.m. With high speed Vertical Milling Attachment, Slotting Attachment, Universal Dividing Head, chuck, change gears, rotary table, etc.

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ASQUITH Two Spindle Profile Milling Machine. Capacity 24in. by 28in. Spindle speeds 250 to 3,000 r.p.m.

WOTAN 16in. Crank Shaping Machine.

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JONES & SHIPMAN "Electrotap", with quantity of leaders.

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KEARNS O.B. Horizontal Boring Machine. 2¾in. Spindle. Spindle Speeds 15/600 r.p.m. Excellent condition.
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KITCHEN & WADE Vertical Fine Boring Machine, 14in. stroke. Compound table.

DRILLING MACHINE

ARCHDALE 8-Spindle Hydraulic Vertical Drilling Machine.

GRINDING MACHINES

BROWN & SHARPE No. 2 Surface Grinder 18in. × 6in. table.
KELLER No. R6 Tool and Cutter Grinder.
LUMSDEN D.E. Tool Grinder.
HEALD No. 172 Gap Bed Internal Grinding Machine, maximum diameter of component 36in.

LATHES

N.D. 8in. × 6ft. S.S. & S.C. Lathe. 30in. between centres.
SMALLPIECE Lathe, type 6 WSLMS.
NOBLE & LUND Heavy Duty Centre Lathe. 22in. centre height × 29ft. between centres Max. swing over saddle 33in. dia.
HARVEY Heavy Duty Centre Lathe. 42½in. centre height × 52ft. between centres. Max. swing over saddle 65in. dia.

MILLING MACHINES

EDGWICK No. 2 Universal Milling Machine. Working surface of table 38in. × 7½in.
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COLLET & ENGLEHARDT Keller Type, Die Sinking Machine. Model FKf80, capacity 60in. × 30in.

PLANING MACHINES

CLEVELAND Openside Planing Machine, capacity 10ft. × 2ft. 6in.
CINCINNATI Planing Machine, capacity 8ft. × 2ft. 6in.

MISCELLANEOUS MACHINES

Hydraulic Vertical Internal Honing Machine (manufactured by **PETER WOLTERS**), Capacity 0.2in. to 2in.
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RHODES Guillotine, 8ft. × ¼in., motorised. Price £750
RHODES Press Brake, 4ft. × ⅛in., single pulley drive. Price £250
RHODES Press Brake, 10ft. × ¼in., undercranked, motorised. Price £500
RHODES Press Brake, 4ft. × ⅛in., single pulley. Price £135
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CINCINNATI Plain Grinder, 10in. × 36in., Model "ER" (As New), Late 1957. Price £1,550
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ARCHDALE 20in. Horizontal Miller, dial type feeds and speeds, 615 r.p.m. Price £395
DEAN, SMITH & GRACE 6½in. Centre Lathes, taper turning, full equipment. Price £575 each
TOWN Radial Drilling and Tapping Machine, 6ft. arm rise and fall, tee slotted, low base, No. 5 Morse taper. Price £675
RICHMOND 0.3 Plain Miller. Price £300
STANLEY 11in. Heavy Duty Lathe. Price £1,250
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2 off—**BROWN & SHARPE** No. 13 Universal Tool and Cutter Grinders, complete with equipment. Price £425 each
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BUTLER 3ft. Openside Planer with side head.
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KENDALL & GENT 6in. Screwing Machine, 3in. bolts, 6in. tubes. Tangential die head with leadscrew.
KENDALL & GENT 3in. tangential die head Screwing Machine with leadscrew.
LANDIS 1½in. Tangential Die-Head Screwing Machine.
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BETTS 12in. stroke heavy duty Slotting Machine.
SWIFT 20in. Slotting Machine.
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ALBA 6S Shaping Machine, 24in. stroke.
BUTLER 12in. Shaper.
BROOK 24in. Shaping Machine, swivel table and auto. hold down feed. (New.)
ORMEROD 26in. stroke Traversing Head Shaper; two universal tables (1953).

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JONES & SHIPMAN "Electrotap" Vertical Tapping Machine, leadscrew control with auto cycle for depth, reverse and stop, 1½in. stroke, 200 r.p.m.
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HERBERT No. 7 Combination Turret Lathes; hollow spindle 2$\frac{13}{16}$in. dia., 16in. swing, speeds 18-366 r.p.m.
HERBERT No. 12 Combination Turret Lathe; roller bearing spindle; covered vee bed, swing over bed 23½in.; hollow spindle 6½in. dial, good equipment; chasing saddle with automatic sliding and surfacing feeds.
HERBERT No. 21 Combination Turret Lathe; swing 28in. over the bed; 7½in. hollow spindle; chasing saddle with automatic sliding and surfacing feeds.
HERBERT No. 4 Senior Capstan Lathe; 15½in. swing over bed, 40-1,000 r.p.m.
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No. 12 **RYDERMATIC** three slide Vertical Multi-tool Lathe; maximum swing 20in.; maximum length 16in.; vertical slide stroke 8in.; horizontal slide stroke 5½in.

DRILLING MACHINES

TOWN 5ft. Radial Drilling Machine; spindle No. 5 Morse taper; speed 26-580 r.p.m.
TOWN 8ft. Non-elevating Arm Radial Drill, with box bed, 122-790 r.p.m. No. 5 Morse Taper.
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SEGIC (Swedish) 27in. Radial Drilling Machine, 1½in. capacity, speed 80-890 r.p.m. (New.)

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CINCINNATI 3/36 Hydromatic Miller. Speeds 8–200 r.p.m. Table size 52¾in. by 14in. Single cycle.

ARCHDALE 30in. Vertical Miller with Power Operated Rotary Table. Table 47in. by 14½in. Long. traverse 34in. M.D. 400/3/50.

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ORMEROD 8in. Production Slotter. 4 ram speeds 23–71 r.p.m. 18in. dia. circular table. Ram face to back of throat 15½in. F. & R. to all traverses. M.D. 400/3/50.

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TOWN 4ft. Radial, Low Base, Loose Box, S.P.D. £275.
ARCHDALE Heavy Duty, 36in. Pillar. £375.

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No. 2 **WARNER & SWASEY** Capstan Lathe. Chucking.

2D **HERBERT** Bar Feed Capstan.

No. 3 **GISHOLT** Chucking Capstan.

43in. × 12in. **FITZ WERNER** Vertical Miller. Swivelling head.

U3 **VICTORIA** Universal Milling Machine with Vertical and Slotting attachments. 8 years old.

20in. **ARCHDALE** Plain Miller. Power feeds and rapids. Spindle speeds 60-1,230 r.p.m.

20in. **ARCHDALE** Plain Miller. Power feeds and rapids. Spindle speeds 30-615 r.p.m.

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No. 2 **KITCHEN & WADE** Honer.

11in./16in. **NOBLE & LUND** Hydraulic Cold saw with Hydraulic clamp.

Model **HBY CHURCHILL** Electrical Grinder.

14in. **BUTLER** Slotter. Power revolving table.

8in. **FABIUS** S.S. & S.C. Lathe. 5ft. between centres. As new.

No. 3 **RICHARDS** Horizontal Borer Model PRT3.

No. 3 **KEARNS** Horizontal Borer.

No. 2 **KEARNS** Horizontal Borer.

8in. **REED PRENTICE** Lathe 6ft. 6in. between centres.

16in. **CRAVEN** Lathe 20ft. between centres.

54in. × 15in. **CRAVEN** Universal Milling Machine.

HERBERT S.E. Capstan Lathe.

24in. **ORCUTT** Automatic Gear Grinder (New).

4A **LIBBY** Turret Lathe.

CRAVEN Worm Milling Machine.

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Crank Pin Turning Machine

Mfr. RICHARDS—Single Head Type with rotating cutter head and stationary crank shaft.

Main dimensions :—

Slide travel	12in.
Dia. revolvs disc	24in.
Work table	4 ft. 10in. by 3ft. 6in.
Main motor	35 H.P.
Feed motor	6½ H.P.

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BULLARD Multi-Au-Matic 7in. 8 spindle.
BULLARD Multi-Au-Matic 12in. 6 spindle.

BORING MACHINES

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KEARNS No. 4 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle.
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CAPSTAN AND CENTRE LATHES

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WARD 7B Combination Turret Lathe.
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U.L.R.O. Heavy Duty Centre Lathe, 16in. centre height × 30ft. between centres.

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GLEASON 3in. Straight Bevel Gear Generator.

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CHURCHILL Plain Hydraulic Cylindrical Grinding Machine, 20in. swing × 72in between centres.
BROWN & SHARPE Plain Cylindrical Grinding Machine, 10in. swing × 36in. between centres.

MILLING MACHINES

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CINCINNATI Model 5/72 Plain Hydromatic Milling Machine, table 91in. × 22in. (1952).
CINCINNATI No. 2L Plain Horizontal Milling Machine, table 52in. × 10in.
CINCINNATI No. 1M Vertical Milling Machine.
CINCINNATI No. 4 Dial Type Horizontal Milling Machine.
PRATT & WHITNEY Model BL3620 3-spindle "Keller" Die Sinking Machine.
CENTEC Model 3R Automatic Production Milling Machine, table 25in. × 16in.

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KEARNS No. 5 "Patent" type, with travelling spindle 5in. diameter, continuous automatic facing head, facing capacity 55in.; table (main) 80in. × 48in.; top table 60in. × 60in.; maximum distance spindle nose to outer stay 14ft.; spindle speeds 2.3-208 r.p.m.; h.p. motor 20. Extra long.

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Classified Advertisements (*PLANT FOR SALE, contd.*)

Classified Advertisements (*PLANT FOR SALE, contd.*)

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SCHIESS DE-FRIES Floor Type Horizontal *BORING MACHINE*. 4½in. dia. spindle. 22in. dia. facing head. Spindle speeds 4·3 to 210 r.p.m. 8ft. traverse of head. Motor drive 400/3/50. Price: £3,250

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SENIOR Plain Horizontal *MILLING MACHINE*. Table size 25in. × 6½in., 12 spindle speeds 50 to 1,660 r.p.m. Power feed to longitudinal movement. Motor drive 400/3/50. **Price £275**

WEBSTER & BENNETT 36in. *VERTICAL BORING AND TURNING MILL*. Table speeds by Murray Colour Control 8·6 to 196 r.p.m. Fitted with pentagonal tool turret. Motor drive 400/3/50. Price: £1,950

DEAN, SMITH & GRACE Model 13.Z 6½in. All Geared Head S.S. & S.C. Straight Vee *BED LATHE*. Admits 30in. between centres. Spindle speeds 29 to 889 r.p.m. Enclosed feed gear box. With taper turning attachment. Motor drive 400/3/50. Price: £475

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Classified Advertisements (*PLANT FOR SALE, contd.*)

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J. E. RAISTRICK LIMITED,
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Automatics. 2A Peterman ⅝in. capacity with four tool slides, 3 spindle combination, drilling and screwing attach., gears, etc. Good cond. Seen running London S. —Telephone: Prospect 8237 or write BOX D66, MACHINERY, Clifton House, Euston Road, N.W.1.

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Tender forms obtainable from the Borough Engineer must reach me by 10 a.m. on 30th August, 1961.

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Town Clerk.

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(about two miles from the centre of the City)

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View Days: 10th, 11th and 14th August, also morning of Sale.

Catalogues (1s. each, P.O.s only), obtainable from the Auctioneers' Offices, Dept. M.C., 20/21, King Street, Hereford. (Tel. 4366, 3 lines)

SITUATIONS VACANT

If you do not wish your reply to any Box No. advertisement in this section to be forwarded to certain firms, please advise us. Your reply will then be destroyed, but you will not be notified as this would disclose the identity of the advertiser.

Automatics Expert Required for sale and service of Continental precision machine tools from London. Experience with tooling design and layout for Swiss-type autos essential. Must have personality to advise clients. Interesting, well-paid post for someone who likes mixture of inside and outside work.—BOX C957, MACHINERY, Clifton House, Euston Road, N.W.1.

Extrusion Engineers. American company requires senior engineers with experience of impact extrusion and related subjects.—First class men with technological and production experience are invited to apply in the first instance to HARMSWORTH, TOWNLEY & CO., Jordan Street, Manchester 15.

The Mulhead Engineering Co.Ltd.
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1. SENIOR MACHINE TOOL DESIGNER
Must be a man with established record in this field, preferably with experience of Rotary Transfer Machines and Unit Heads.
2. SENIOR AND JUNIOR JIG AND TOOL DRAUGHTSMEN for design and detailing of fixtures and Multi-Spindle Drill Heads.

Housing will be available in Hatfield for selected applicants.

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Engineering Assistant Required to take charge of service and spares department in London area. Must have shop experience and some commercial knowledge.—Apply in writing to ALFRED HERBERT, LTD., 70, Vauxhall Bridge Road, London, S.W.1.

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One of the Companies of a large and expanding organisation requires a Works Engineer with considerable practical experience of Works maintenance and hydraulics.

Applicants should be capable of designing modifications to existing machinery, to improve machine utilisation and increase production. Ability to control staff is essential.

The appointment offers excellent welfare facilities, a non-contributory pension fund and assistance with house purchase, if required.

The salary will be between £1,250 and £1,500, according to experience.

Replies to:

BOX D.121, MACHINERY,
Clifton House, Euston Road, N.W.1.

CAM & TOOL DESIGNER REQUIRED

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Applications to Personnel Office :

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INLAND REVENUE VALUATION OFFICE

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Pensionable posts in offices in England and Wales and in Scotland for qualified men and women at least 24 and under 34 on 1.10.61; extension for candidates with regular Forces service or Overseas Civil Service. Vacancies are in District (Revenue and Compensation) and Area (Rating) offices and include posts for valuation of minerals, plant and machinery, and licensed property. Vacancies in Scotland are in District (Revenue and Compensation) offices only. Qualifications: Final examination of R.I.C.S., C.A. and E.A.I., or C.L.A.S., or B.A. (Cantab.) or B.Sc.(Lond.) in Estate Management. At least 4 years' professional (or mining, for valuation of minerals posts) experience. For Scottish posts experience in Scotland desirable, and qualifying examination preferably based on Scottish syllabus. For valuation of mineral posts, 1st Class Certificate of Competency (Mine Managers) acceptable as professional qualification. Starting salary (Inner London) from £913 (24) to £1,318 (34 or over); scale maximum £1,490. Promotion prospects. Write Civil Service Commission, Burlington Gardens, London, W.1, for application form, quoting **149/61/8.** Closing date 17th October, 1961.

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Appointments will, in the first instance, be for four years and Agreements will provide for free quarters, passages for family and medical attention and generous Provident Fund and Home Leave.

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Salary: Burnham Technical Scale—at present £1,370 to £1,550 p.a.

Further particulars and application forms may be obtained from the Registrar, Leicester College of Technology and Commerce.

Classified Advertisements (*SITUATIONS VACANT, contd.*)

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Please write giving full details of age, experience and technical education to

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FORD MOTOR COMPANY LTD DAGENHAM ESSEX
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Works Manager Required For foundry in North West London. The essential requirements are age limit 30-40, a thorough knowledge of tool shop management and sound die casting foundry experience. This appointment provides scope for man with energy, drive and initiative.—Apply BOX D131, MACHINERY, Clifton House, Euston Road, N.W.1.

Engineer with Managerial Ex- perience of small Companies to assist in rapidly growing Company in S. Devon. Tool-makers, Presswork and Specialised Products. Opportunity for keen Engineer with good training. Tool design experience an advantage.—Full details in confidence to MANAGING DIRECTOR, BOX D124, MACHINERY, Clifton House, Euston Road, N.W.1.

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BOX D 116 MACHINERY
Clifton House, Euston Rd., N.W.1

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Dept. 'SM', W. J. Meddings Ltd., Ipswich Road, Trading Estate, Slough, Bucks.

SITUATIONS WANTED

Executive Engineer, 35, Grad. I.E.D., R.S.A. Cert. Practical Training. Experienced in most aspects of light electro-mechanical engineering. Customer liaison at all levels, Design and Development. Seeks an interesting and progressive position. Present salary £1,250 plus company car.BOX D125, MACHINERY, Clifton House, Euston Road, N.W.1.

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Senior Technical Editor, Now at height of successful career in technical journal and book publishing, wants to change to running a technical publications unit for a manufacturing concern. He believes that the future of original technical literature lies in this direction. Author of many books and articles explaining complex ideas in simple, lucid English. Some advertising experience.—BOX D98, MACHINERY, Clifton House, Euston Road, N.W.1.

Mechanical Engineer, A.M.I.- Mech.E., aged 40, broad works management experience light electrical and mechanical engineering seeks responsible post. August, preferably within 15 miles Weybridge.—BOX D115, MACHINERY, Clifton House, Euston Road, N.W.1.

Works Manager, 6 Years Project engineer in chemical engineering. Apprenticeship and previous background associated with production engineering. Experience in Production methods and tooling including plastics. Previous positions held, Assistant Works Manager. Wish to revert to Works Management. Age 38 years. Position preferred South of England.—BOX D128, MACHINERY, Clifton House, Euston Road, N.W.1.

Young Engineer (26), Hungarian born, well educated. Married. At present design draughtsman. Seeks permanency. Gen. Eng. Ind. Finishing Instruments. S.E. London/Kent. Would prefer small firm where hard work appreciated.—BOX D120, MACHINERY, Clifton House, Euston Road, N.W.1.

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Motorised Workhead for Brown & Sharpe No. 13 Universal Tool Grinder. —BOX D102, MACHINERY, Clifton House, Euston Road, N.W.1.

Slotting Machine Required, approx. 12in. stroke, 24in. Minimum throat. Tilting head-slide and rotary table (Pratt & Whitney Machine preferred).—Full details to BOX D126, MACHINERY, Clifton House, Euston Road, N.W.1.

Heat Treatment Furnaces and Salt Baths, hardness testing equipment, etc.—BOX D130, MACHINERY, Clifton House, Euston Road, N.W.1.

Wanted Drummond Maxicut 3A Gear Shaper.—BOX D133, MACHINERY, Clifton House, Euston Road, N.W.1.

PATENTS—TRADE MARKS

The Proprietor of British Patent No. 773115 for "Means For Admitting Hot Air or Water Vapour To the Induction Systems of Internal Combustion Engines," desires to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. Further particulars may be obtained from MARKS & CLERK, 57 and 58, Lincoln's Inn Fields, London, W.C.2.

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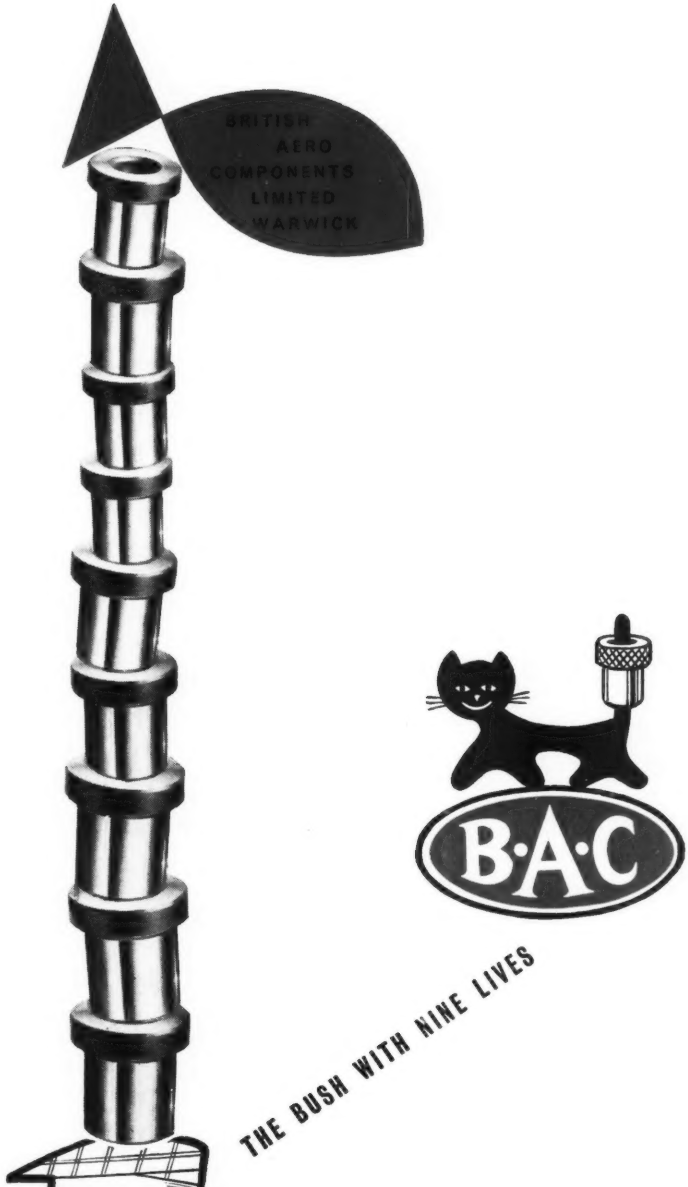
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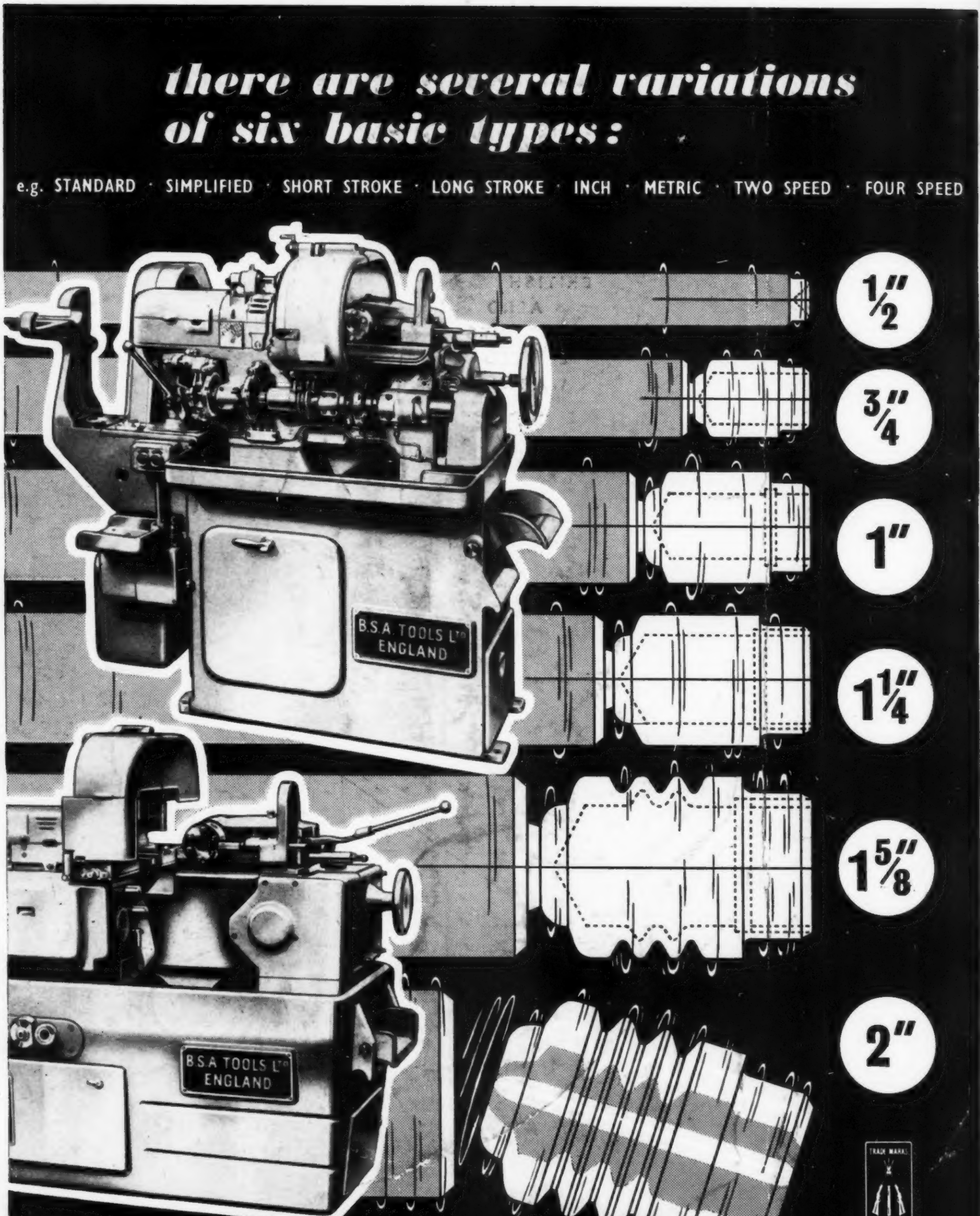

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